

EPA ID: MAD001127224 Site Name: AMERICAN OPTICAL CO

State ID:

Alias Site Names: AMERICAM OPTICAL SITE A
AMERICAN OPTICAL SITE I & II

City: SOUTHBRIDGE

County or Parish: WORCESTER

State: MA

Refer to Report Dated: 09/29/98

Report Type: Site Inspection Prioritization 001

Report Developed by:



SEMS DocID 643389

DECISION:

- ☐ 1. Further Remedial Site Assessment under CERCLA (Superfund) is not required because:
- ☐ 1a. Site does not qualify for further remedial site assessment under CERCLA (No Further Remedial Action Planned - NFRAP)
- ☐ 1b. Site may qualify for action, but is deferred to:
- ☒ 2. Further Assessment Needed Under CERCLA:
- 2a. Priority: ☐ Higher ☒ Lower
- 2b. Other: (recommended action)

DISCUSSION/RATIONALE:

Release to SW documented. No drinking water supplies impacted.

Site Decision Made by: NANCY SMITH

Signature: _____

Nancy Smith

Date: 10/07/98

**FINAL SITE INSPECTION PRIORITIZATION REPORT
FOR
AMERICAN OPTICAL CO.
SOUTHBRIDGE, MASSACHUSETTS**

Prepared For:
U.S. Environmental Protection Agency
Region I
Office of Site Remediation and Restoration
John F. Kennedy Federal Building
Boston, MA 02203-0001

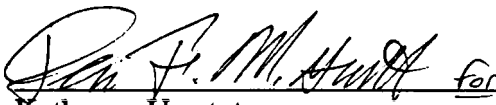
CONTRACT NO. 68-W5-0009

CERCLIS NO. MAD001127224
TDD NO. 98-05-0089
PCS NO. 5022
DC NO. A-3215


Submitted By:
Roy F. Weston, Inc. (WESTON®)
Superfund Technical Assessment and Response Team (START)
217 Middlesex Turnpike
Burlington, MA 01803

29 September 1998

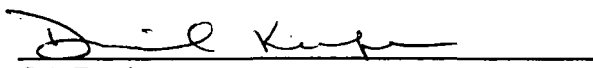
Region I START
Reviewed and Approved:


Katharyn Umstot
Site Leader

9/29/98
Date


David Gorden
Work Group Leader

9/29/98
Date


QA Review

9/29/98
Date

Work Order No. 11098-031-001-5022-70

DISCLAIMER

This report was prepared solely for the use and benefit of the U.S. Environmental Protection Agency Region I (EPA Region I), Office of Site Remediation and Restoration for the specific purposes set forth in the contract between the EPA Region I and the Roy F. Weston, Inc. (WESTON®), Superfund Technical Assessment and Response Team (START). Professional services performed and reports generated by START have been prepared for EPA Region I purposes as described in the START contract. The information, statements, and conclusions contained in the report were prepared in accordance with the statement of work, and contract terms and conditions. The report may be subject to differing interpretations or misinterpretation by third parties who did not participate in the planning, research or consultation processes. Any use of this document or the information contained herein by persons or entities other than the EPA Region I shall be at the sole risk and liability of said person or entity. START, therefore, expressly disclaims any liability to persons other than the EPA Region I who may use or rely upon this report in any way or for any purpose.

TABLE OF CONTENTS

| <u>Title</u> | <u>Page</u> |
|---|--------------------|
| INTRODUCTION | 1 |
| SITE DESCRIPTION | 1 |
| OPERATIONAL AND REGULATORY HISTORY AND WASTE CHARACTERISTICS | 8 |
| WASTE/SOURCE SAMPLING | 17 |
| GROUNDWATER PATHWAY | 19 |
| SURFACE WATER PATHWAY | 26 |
| SOIL EXPOSURE PATHWAY | 31 |
| AIR PATHWAY | 32 |
| SUMMARY | 35 |
| REFERENCES | |

LIST OF FIGURES

| <u>Figure No.</u> | <u>Title</u> | <u>Page</u> |
|-------------------|--|-------------|
| 1 | Location Map | 2 |
| 2 | Site Sketch | 3 |
| 3 | Surface Water Pathway Sketch | 27 |

LIST OF TABLES

| <u>Table No.</u> | <u>Title</u> | <u>Page</u> |
|------------------|---|-------------|
| 1 | Potential Sources Located at American Optical Co. | 5 |
| 2 | Current Tenants Leasing Buildings on the American Optical Co. Property | 8 |
| 3 | Source Evaluation for American Optical Co. | 12 |
| 4 | Hazardous Waste Quantity for American Optical Co. | 14 |
| 5 | Public Groundwater Supply Sources Within 4-Radial Miles of American Optical Co. | 20 |
| 6 | Estimated Drinking Water Populations Served by Groundwater Sources Within 4-Radial Miles of American Optical Co. | 21 |
| 7 | Surface Water Bodies Along the 15-Mile Downstream Pathway from American Optical Co. | 28 |
| 8 | Sensitive Environments Along the 15-Mile Downstream Pathway from American Optical Co. | 29 |
| 9 | Estimated Population Within 4-Radial Miles of American Optical Co. | 33 |
| 10 | Sensitive Environments Located Within 4-Radial Miles of American Optical Co. | 34 |

**Final Site Inspection Prioritization Report
American Optical Co.
Southbridge, Massachusetts**

**CERCLIS No. MAD001127224
TDD No. 98-05-0089
Work Order No. 11098-031-001-5022-70**

INTRODUCTION

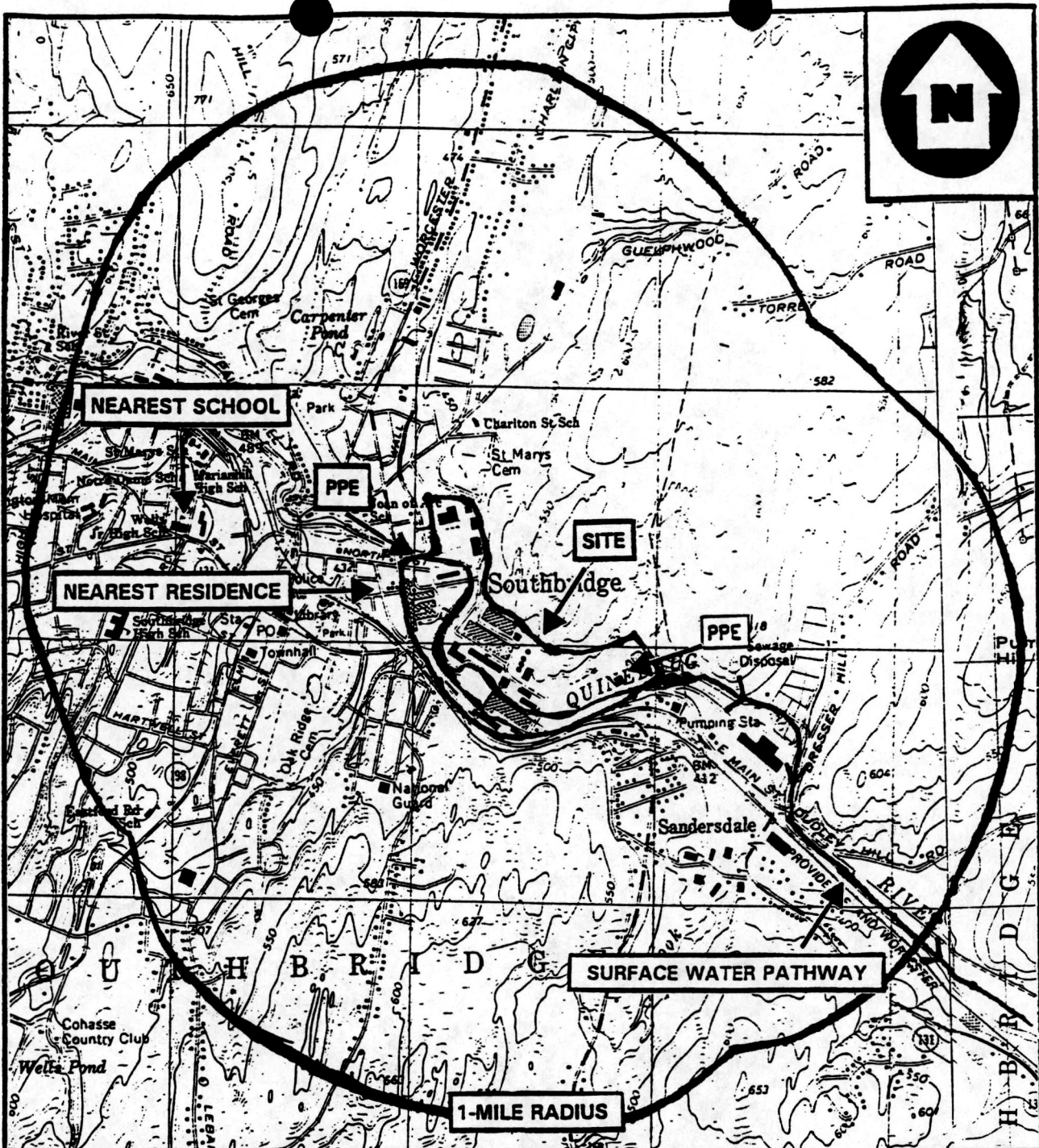
The Roy F. Weston, Inc. (WESTON®) Superfund Technical Assessment and Response Team (START) was requested by the U.S. Environmental Protection Agency Region I (EPA Region I), Office of Site Remediation and Restoration to perform a Site Inspection Prioritization (SIP) of the American Optical Co. property at 14 Mechanic Street in Southbridge, Massachusetts. Tasks were conducted in accordance with the SIP scope of work and technical specifications provided by EPA Region I. A Screening Site Inspection (SSI) Report for the American Optical Co. property was prepared by the NUS Corporation Field Investigation Team (NUS/FIT) on 25 September 1990. The SSI summarized site conditions and potential areas of concern associated with the American Optical Co. property. On the basis of the information provided in the SI report and the status of additional RCRA investigations, the American Optical Co. SIP was initiated.

Background information used in the generation of this report was obtained through file searches conducted at the EPA Region I, Massachusetts Department of Environmental Protection (MA DEP), telephone interviews with town officials, conversations with persons knowledgeable of the American Optical Co. property and conversations with other Federal, State, and local agencies.

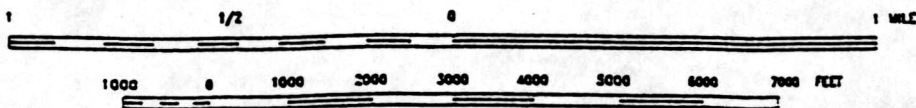
This package follows the guidelines developed under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended, commonly referred to as Superfund. However, these documents do not necessarily fulfill the requirements of other EPA Region I regulations such as those under the Resource Conservation and Recovery Act (RCRA) or other Federal, State, or local regulations. SIPs are intended to provide a preliminary screening of sites to facilitate EPA Region I's assignment of site priorities. They are limited efforts and are not intended to supersede more detailed investigations.

SITE DESCRIPTION

The American Optical Co. property is located at 14 Mechanic Street in the Town of Southbridge, Worcester County, Massachusetts, in an area zoned for heavy industrial use (Figure 1) [1]. The property consists of four parcels referenced on the Southbridge Tax Assessor's Map No. 29, Parcel No. 38; Map No. 37, Parcel Nos. 4 and 5; and Map No. 38, Parcel No. 1 [2, p. 11]. There are approximately 37 buildings and numerous smaller storage buildings, located on the 140-acre American Optical Co. property [10]. The property is bordered by Mechanic Street to the west, East Main Street to the south, woods to the east, and St. Mary's Cemetery to the north (Figure 2). The Quinebaug River flows through the property from northwest to southeast [1]. Mr. David Butler of American Optical Co. indicated that the current American Optical Co. property is bordered to the north by the northern bank of the Quinebaug River and to the south by Schott Fiber Optics, Inc. (including the AO Ballfield Landfill) and not by St. Mary's Cemetery. The Schott Fiber Optics, Inc. property was part of American Optical Co. until 29 May 1982 [61].



BASE MAP IS A PORTION OF THE 7.5 X 15' U.S.G.S. QUADRANGLE SOUTHBRIDGE, MA (1962)



LOCATION MAP

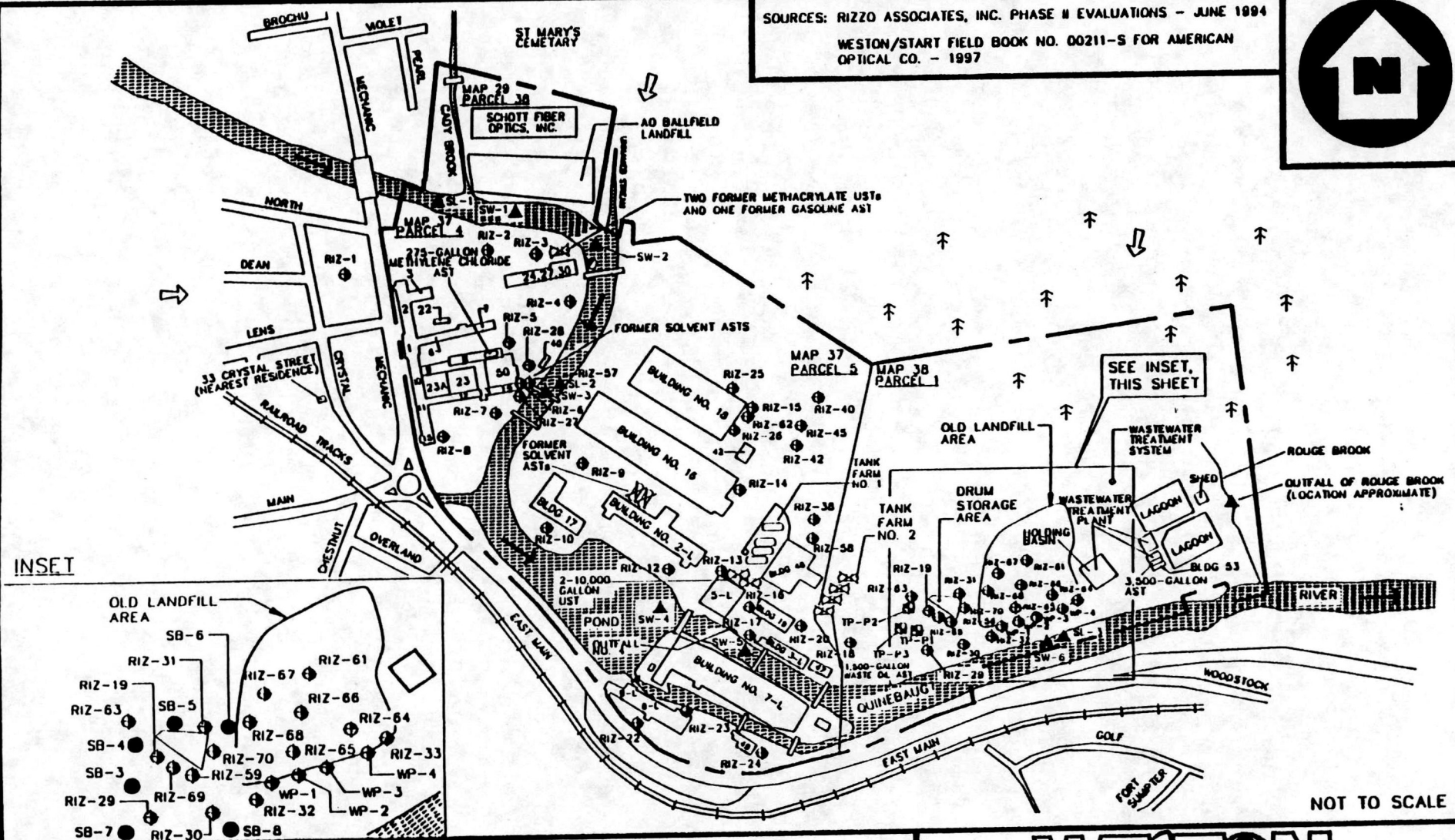
AMERICAN OPTICAL CO.
14 MECHANIC STREET
SOUTHBRIDGE, MASSACHUSETTS



REGION I SUPERFUND TECHNICAL ASSESSMENT AND RESPONSE TEAM

| | | |
|----------------------|-----------|---------|
| TDD # | DRAWN BY: | DATE |
| 97-06-0016 | K.UMSTOT | 9/02/97 |
| FILE NAME: | FIGURE 1 | |
| S:\970600\6\FIG1.DWG | | |

SOURCES: RIZZO ASSOCIATES, INC. PHASE II EVALUATIONS - JUNE 1994
 WESTON/START FIELD BOOK NO. 00211-S FOR AMERICAN
 OPTICAL CO. - 1997



LEGEND

| | | | |
|--|---|--|------------------------------|
| | SURFACE WATER BODY | | TREE |
| | ABOVEGROUND STORAGE TANK (AST) | | BUILDING |
| | FORMER AST | | PROPERTY LINE (FORMER) |
| | UNDERGROUND STORAGE TANK (UST) | | SURFACE WATER FLOW DIRECTION |
| | GROUNDWATER FLOW DIRECTION | | DRUM STORAGE AREA |
| | MONITORING WELL (SCREEN INTERVAL INDICATED) | | TEST PIT |
| | | | SOIL SAMPLE |
| | | | SURFACE WATER SAMPLE |
| | | | GAGING STATION |

SITE SKETCH

AMERICAN OPTICAL CO.
 14 MECHANIC STREET
 SOUTHBRIDGE, MASSACHUSETTS

WESTON
 MANAGERS DESIGNERS/CONSULTANTS

REGION I SUPERFUND TECHNICAL ASSESSMENT AND RESPONSE TEAM

TOD #
 98-05-0089

DRAWN BY:
 W. SHAW

DATE
 8/12/98

FILE NAME:
 S:\97060016\FIG2

FIGURE 2

In the late 1800s, a dam was constructed on the Quinebaug River and, as a result, Powerhouse Pond was created. The water from Powerhouse Pond was used to generate hydroelectric power for operations on the property until 1966 [4; 61]. A small perennial stream, Rouge Brook, originates on the southeast portion of the property, and discharges to the Quinebaug River [1].

The on-site powerhouse, located in Building No. 5-L in the southern portion of the property, is an 8-megawatt No. 6 oil-fueled power cogenerating plant that produces electricity and steam for the American Optical Co. facility. American Optical Co. maintains a fuel oil tank farm storage area (Tank Farm No. 1, located northeast of the Building No. 5-L) associated with the powerhouse. Tank Farm No. 1 consists of two 150,000-gallon and two 300,000-gallon No. 6 fuel oil ASTs. The northernmost 300,000-gallon AST is no longer in service.

American Optical Co. utilized Building No. 42, referred to by American Optical Co. personnel as the Oil House, as a hazardous waste, petroleum, and virgin product storage building until June 1996, when its use was relinquished to American Optical Lens Company (a separate entity not affiliated with American Optical Co.) [13, p. 13; 61].

On 13 October 1997 START conducted an on-site reconnaissance of the American Optical Co. facility to verify current site conditions. START observed two freezers [reported to formerly contain isopropyl percarbonate (IPP)] and an experimental purifying reactor, with CR39 acrylic resin crystals present on the reactor and the floor surrounding the reactor located in Building No. 40. Building No. 40 is used for storage space by American Optical Co. Building No. 40 is constructed of concrete, and has no floor drains [10, p. 21]. Building No. 40 was reportedly previously monitored on a weekly basis by the Pollution Control Facilities Leader [13, p. 5].

START observed two silos located east of Building No. 8 that were reported to contain polyvinyl chloride (PVC) pellets. Additionally, START observed three transformers containing polychlorinated biphenyls (PCBs) located in the basement of Building No. 50. The transformers were located on wooden slats on a concrete floor; a manhole, connected to the municipal sewer, was located approximately 10 feet (ft) from the transformers [10, p. 8]. American Optical Co. representatives report that the transformers were removed in December of 1997 [60]. Two active transformers containing PCBs are located in Building No. 11. START observed staining on the floor that may indicate that the transformers had previously leaked; however, the floor is concrete and will likely reduce/limit the spread of hazardous materials [10, p. 9].

START observed an electrical substation with transformers containing PCBs outside of Building No. 5-L. Stained gravel was observed beneath the transformers. The area beneath the substation had a concrete pad, but was not bermed [10, p. 16]. American Optical Co. representatives report that the transformers did not contain PCBs [60]. Other PCB- and non-PCB-containing transformers were observed by START throughout the property; however, no other transformers appeared to be leaking.

START observed a 275-gallon AST located in the basement of Building No. 8. American Optical Co. reported that the AST was installed in the late 1970s. The AST was previously used as a methylene chloride recovery tank. START observed staining on the concrete floor below the

AST. Additionally, a pump/sump system (used for the removal of flood water during flood season) is located next to the AST. The pump/sump system is still connected to Outfall No. 014, but is no longer in use [10, p. 10].

START observed seven 55-gallon drums containing waste oil (five of the drums contained a water/oil mixture from the rinsing of the two UST holding tanks) located outside the powerhouse. Additionally, a compressed oxygen cylinder was located outside the powerhouse [10, p. 17]. Building No. 3-L contained seven 20-gallon drums of sulfuric acid and an AST (estimated 10,000 gallon capacity) that formerly contained an unspecified effluent from Building No. 2-L, and currently contains a small amount of cerium oxide sludge according to American Optical Co. personnel [10, p. 19].

START observed several retired (not in service) A, B, and C type fire extinguishers throughout the buildings on the property, including numerous retired fire extinguishers in "fire extinguisher storage areas" located in Building Nos. 50, 7, and 22. START observed approximately 20 20-pound fire extinguishers stored on the floor in the basement of Building No. 50 near floor drains connected to the municipal sewer system [10, p. 8].

Due to the size of the property, START conducted a second reconnaissance in order to observe the remaining areas. During the 26 November 1997 START on-site reconnaissance, START observed stained soil and a sheen on an adjacent waterway (within the tank farm containment area) from a spill of No. 6 fuel oil (estimated at between 150 and 200 gallons) from one of the ASTs in Tank Farm No. 1 [10; 61]. American Optical Co. representatives informed START that MA DEP was notified of the 24 November 1997 oil spill.

During the 13 October and 26 November 1997 START on-site reconnaissances, START monitored on-site air quality with a photoionization detector (PID). No readings above background were recorded on 26 November 1997. One reading above background was recorded during the 13 October 1997 on-site reconnaissance. This elevated reading was located at an unlocked, unidentified monitoring well in the vicinity of the Old Landfill Area. Table 1 summarizes the potential sources located on the American Optical Co. property.

Table 1
Potential Sources Located at American Optical Co.

| Source Name | Years of Operation/Storage | Processes | Potential Hazardous Waste/Discharge |
|---|----------------------------|--|--|
| Transformers | Unknown to Present | Transmission of electricity | PCBs |
| Wastewater Treatment Plant Contaminated Soil | 1968 to Present | Iron oxide and emery (aluminum oxide) sludge fill | Iron oxide and emery (aluminum oxide) sludge |

Table 1

Potential Sources Located at American Optical Co. (Continued)

| Source Name | Years of Operation/Storage | Processes | Potential Hazardous Waste/Discharge |
|--|--|---|--|
| Wastewater Treatment Plant Associated Lagoons | 1968 to Present | Deposition of process waste | Wastewater; possibly VOCs and metals |
| Building No. 5 ASTs (One 3,500- gallon AST and one 1,500-gallon AST) | 1968 to Present | Storage of flocculation chemicals | Flocculation chemicals |
| Former Wastewater Treatment Plant (Building No. 16) 55-gallon drums | Unknown to 1987 | Neutralization process for plating waste | Heavy metals |
| Powerhouse (55-gallon waste-oil drums) | Unknown to Present | Power production fueled by oil | Waste oil |
| Powerhouse USTs | Unknown to 1997 | Storage, mixing, and day tanks for the powerhouse. | Unknown |
| Tank Farms (Nos. 1 and 2) | Early 1900s to present, and unknown to 1988, respectively | Storage of fuel oil | Fuel oil |
| 1,500-gallon Waste Oil AST | Unknown to 1988 | Storage of waste oil | Waste oil |
| Two 500-gallon TCA and two 500- gallon DCM ASTs (formerly located east of Building No. 14) | Unknown to 1988 | Storage of TCA and DCM | TCA and DCM |
| Historic Product USTs (formerly located throughout the property) | Early 1900s to Unknown | Storage of petroleum products, benzene, and naphtha | Petroleum products, benzene, and naphtha |
| Two 500-gallon ASTs (located adjacent to Building No. 2-L)* | 1988 to 1993 | Storage of DCM | DCM |
| Two Former Methyl Methacrylate USTs (Building Nos. 24, 27, and 30) | Unknown to 1988 | Historically stored methyl methacrylate | Methyl methacrylate |
| 4,000-gallon gasoline UST, (Building Nos. 24, 27, and 30) | 1988 to Present (unconfirmed) | Storage of gasoline | Gasoline |
| Oil House (Building No. 42 and associated 300-gallon AST) | Unknown to Present | Storage of hazardous waste, petroleum products, and virgin products | Hazardous waste |
| Incinerator (and associated ASTs) | 1971 to 1981 | Incinerated production waste | Production waste residue |

Table 1

Potential Sources Located at American Optical Co. (Concluded)

| Source Name | Years of Operation/Storage | Processes | Potential Hazardous Waste/Discharge |
|---|---|---|-------------------------------------|
| Old Landfill Area | 1907 to 1992 | Landfilling of plastic/glass scrap and dredged spoils | Unknown wastes |
| AO Ballfield Landfill | 1978 to present | Landfilling of dredged spoils | Unknown wastes |
| Drum Storage Area | 1974 to Present | Historically stored process waste | Process waste |
| Research Facility (Building No. 17) | Unknown | Storage of hazardous waste | Hazardous waste |
| Former Injection Molding Plant (Building No. 48) | Unknown | Storage of lubricating and hydraulic oil | Lubricating and hydraulic oil |
| Flammable Liquid Storage Area (Building No. 7-L) | Unknown | Storage of flammable liquids | Flammable liquids |
| Building No. 40 Storage Area | Unknown to Present | Two IPP freezers, purifying reactor | IPP, acrylic crystals |
| Vehicle and Ground Services Area (Building Nos. 24, 27, and 30) | Unknown | Storage of small amounts of herbicides and pesticides | Herbicides and pesticides |
| PVC Silos | Unknown to Present | PVC pellet storage | Vinyl chloride release |
| Building No. 8 AST and Sump | Connected from late 1970s to present (no longer used) | Methylene chloride separation | Methylene chloride |
| Building No. 5-L and 3-L drums | Unknown to Present | Storage of oil/water and sulfuric acid | Oil/water and sulfuric acid |
| Building No. 3-L AST | Unknown to Present | Storage of Building No. 2-L unspecified effluent, currently containing sludge | Sludge |
| Fire Extinguishers | Unknown to Present | Storage of retired A, B, and C type fire extinguishers | Type A, B, and C chemicals |

PCB = Polychlorinated Biphenyl

TCA = Trichloroethane

DCM = Dichloromethane

AST = Aboveground Storage Tank

UST = Underground Storage Tank

VOCs = Volatile Organic Compounds

AO = American Optical

PVC = Polyvinyl Chloride

IPP = Isopropyl percarbonate

* = The two DCM ASTs are the same DCM ASTs located outside of Building No. 14 prior to 1988; however they are listed twice because they have potentially contaminated a different area of the property than the original location.

[9; 11; 12; 13; 18]

OPERATIONAL AND REGULATORY HISTORY AND WASTE CHARACTERISTICS

From approximately 1865 until the 1980s, American Optical Co. manufactured eyeglass products such as eyeglass lenses, eyeglass frames, and personal protective equipment such as goggles, safety glasses, and respirators [4]. The processes used in the manufacturing operations included injection molding, plating, parts cleaning with solvents, baking, and freon drying [4]. Waste generated from these processes included: solvents, freon, industrial oils, organic chemicals, plating wastes, inorganic chemicals, acid and alkalies, oil sludge, plating sludges, and various unspecified chemical compounds [4].

In 1987, American Optical Co. sold a portion of the property (consisting of Parcel Nos. 4 and 5 on Southbridge Tax Assessor's Map No. 37, and Parcel No. 1 on Southbridge Tax Assessor's Map No. 38) to Southbridge Association Limited Partnership (SALP) [5; 6]. SALP has leased space in the on-site buildings to several companies, including American Optical Co. since 1987 (Refer to Figure 2 and Table 2 in this document). Many of the current tenants continue to utilize the same manufacturing processes (in the same locations) that were previously performed by American Optical Co. prior to 1987 [7, p. 6]. American Optical Co. currently utilizes their portion of the on-site buildings for wastewater treatment, power generation, offices, and storage. Parcel No. 38 (Map No. 29), currently owned by Schott Fiber Optics, Inc., was purchased from American Optical Co. in 1982 [9, p. 25]. Parcel No. 38 (Map No. 29) is located north of the Quinebaug River and contains the American Optical (AO) Ballfield Landfill (described in a later section). Schott Fiber Optics, Inc. manufactures fiber optics on Parcel No. 38 [8]. Table 2 summarizes the current tenants who lease building space on the American Optical Co. property, and the current processes conducted within these spaces.

Table 2
Current Tenants Leasing Buildings on the American Optical Co. Property*

| Current Tenants | Location | Building No(s). | Use/Processes |
|-------------------------------------|--------------------|-----------------|--|
| AO Lens Company | 14 Mechanic Street | 2 | Prosthetic eye manufacturing and fitting |
| United States Department of Defense | 14 Mechanic Street | 6 | Offices |
| AO Corp. | 14 Mechanic Street | 1, 10 & 15 | Offices |
| Southbridge Credit Union | 14 Mechanic Street | 10 | Bank |
| AEARO (formerly Cabot Safety Corp.) | 35 Optical Drive | 16 | Safety Products Manufacturing |
| Aotec, LLC | 40 Optical Drive | 17 | Offices, Research and Development |
| AO Lens Co. | 25 Optical Drive | 18 | Offices and Warehouse |
| Stonebridge Press | 25 Optical Drive | 18 | Newspaper Printing |
| AO Lens Co. | 15 Wells Street | 18 | Shipping/Receiving |

Table 2

Current Tenants Leasing Buildings on the American Optical Co. Property* (Concluded)

| Current Tenants | Location | Building No(s). | Processes |
|---|---------------------|-----------------|---|
| Imperial Spring Co. | 15 Wells Street | 18 | Wire Spring Manufacturing |
| AEARO (formerly Cabot Safety Corp.) | 70 Optical Drive | 19 | Computer Center |
| Franklin Management | 5 Optical Drive | 24, 27, 30 | Facility Maintenance |
| Industrial Vehicle Maintenance | 5 Optical Drive | 27 | Automotive Service Garage |
| AO Lens Co. | 5 Wells Street | 42 | Chemicals Storage |
| AEARO (formerly Cabot Safety Corp.) | 10 Cabot Street | 48 | Receiving and Warehousing |
| AO Lens Co. | 50 Optical Drive | 2L | Offices, Manufacturing and Research and Development |
| CAFA | 50 Optical Drive | 2L | Offices, Research and Development |
| AO Sunwear (formerly Command Marketing) | 50 Optical Drive | 2L | Metal Frames Manufacturing |
| Wilden Machine Co. | 50 Optical Drive | 2L | Metal Products Manufacturing |
| AO Company | 60 Optical Drive | 5L | Cogen Powerhouse |
| Spec-Elec Plating Corp. | 25 Case Street | 7L | Electroplating |
| Aotec, LLC | 25 Case Street | 7L | Plastics Molding and Coating |
| ALSCO Industries, Inc. | 25 Case Street | 7L | Plastics Molding |
| AEARO (formerly Cabot Safety Corp.) | 25 Case Street | 7L | Vacant Space |
| Center of Hope | 5 Case Street | 8L & 9L | Assembly Work Training Facility |
| Moles Environmental | Lagoon | 53 | Wastewater Treatment |
| Schott Fiber Optics, Inc. | 122 Charlton Street | NA | Manufacturing of Fiber Optics |

* = American Optical Co. did not include current tenant information (if any is applicable) for Building Nos. 3, 22, 7, 8, 9, 23A, 23, 11, 50, and 49. These buildings are likely not in use. Building Nos. 3-L, 40, and 47 are utilized by American Optical Company as storage or maintenance.

AO = American Optical

CAFA = Center for Advanced Fiber Optics Application

NA = Not Applicable; no known building number assigned

[7, Table 1]

In 1968, American Optical Co. began operating a wastewater treatment plant on the southeastern corner of the American Optical Co. property. Currently, the wastewater treatment plant receives wastewater from Building No. 5-L (the American Optical Co. powerhouse) and operates 3 days

per week for approximately 1.5 hours per day [10, p. 12, 14]. Two 100- by 150-foot unlined lagoons, located east of the wastewater treatment plant, are used for final settling of the wastewater sludge [10; 12].

In 1974, American Optical Co. was first issued a National Pollutant Discharge Elimination System (NPDES) Permit No. MA0003361, which allowed American Optical Co. to discharge non-contact cooling water, stormwater, and on-site treated industrial wastewater to the Quinebaug River. Currently, the permit is under consideration for renewal by EPA [10, p. 4]. American Optical Co. currently operates 10 NPDES permitted discharges from the property, along the Quinebaug River [2, p. 12].

In 1978, the Quinebaug River, at Powerhouse Pond, was dredged due to a build up of solids in the pond. The silt was transported to two designated landfill areas on the property (the Old Landfill Area and the AO Ballfield Landfill).

In 1981, American Optical Co. identified and filed with the EPA RCRA Division as a Generator and Transport, Storage, and Disposal (TSD) facility. In 1984, the American Optical Co. RCRA status was changed from a TSD facility and Generator, to Generator only [2, p. 12; 3; 32].

In July 1981, a Preliminary Assessment (PA) was conducted for the American Optical Co. property.

Since 1989, numerous environmental investigations have been conducted on the American Optical Co. property. The following paragraphs summarize these investigations and details of the investigations are discussed on the appropriate pathway sections of this report. The monitoring wells and soil borings which were documented to contain detectable contaminants are shown on Figure 2.

On 8 March 1990, Rizzo Associates, Inc. (Rizzo) completed a *Phase I Limited Site Investigation* report for the American Optical Co. property. As part of the investigation, Rizzo advanced a total of 27 monitoring wells (RIZ-1 through RIZ-20, and RIZ-22 through RIZ-28). Three rounds of groundwater sampling were conducted as part of this investigation. Information regarding this investigation is discussed in the Groundwater Pathway section of this report.

On 25 September 1990, NUS/FIT completed an SSI for EPA. The SSI summarized site conditions and concluded that the American Optical Co. property was being regulated under RCRA [3; 9].

In October 1990, as part of a the follow-up investigation of the Phase I report, Rizzo excavated three test pits (L-1, L-2, and L-8) in Cell No. 1 of the Old Landfill Area; two test pits in Cell No. 2 of the Old Landfill Area (L-3 and L-4); and three test pits (L-5, L-6, and L-7) in Cell No. 3 [21, p. 7]. Three additional test pits (P-1 through P-3) were excavated in the parking area southwest of the landfill (Tank Farm No. 2). Soil samples were collected at undocumented depths and analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides/PCBs, priority pollutant list (PPL) metals, cyanide, and total petroleum hydrocarbons (TPH).

Additionally, in October 1990, as part of the Phase I investigation follow-up, Rizzo reported that nine soil borings were advanced; however, in a summary of laboratory data, Rizzo documented 10 soil borings. Eight of these soil borings were completed as monitoring wells [21, Table 6].

In June 1991, Rizzo submitted a second addendum to the Phase I report. As part of the "Phase I, Addendum 2" investigation, Rizzo collected additional soil samples from Tank Farm No. 1. In March 1991, as part of the Phase I, Addendum 2 investigation, Rizzo installed four monitoring wells east of Building No. 48. Thirteen soil borings were advanced in 1991 as part of the second addendum to the Phase I investigation. The soil borings are located in the area surrounding Building No. 18, located in the northern section of the center of the property. Details of the sampling events are provided in the Soil Exposure Pathway section of this report.

In August 1991, Rizzo completed a *Notice of Deficiency Response* for American Optical Co. which was submitted to MA DEP. As part of the evaluation, Rizzo collected groundwater samples from eight monitoring wells. Rizzo also collected soil samples from the vicinity of Building No. 48, where stained soil was observed. The source of the stained soil was reported to be a discharge pipe, which lead from the truck ramp located at the loading dock to an unspecified location.

In September 1992, Rizzo completed an *Initial Site Assessment* of the landfill located on Parcel No. 3 (the Old Landfill Area). The report included a summary of previous sampling conducted at the landfill [30].

In June 1994, Rizzo completed a *Phase II Comprehensive Site Assessment Report*. A Soil Gas Survey was conducted in the region of the Barrel Storage Area utilizing 50 Gore-Sorber Screening Modules, in order to detect the presence of VOCs and SVOCs.

In June 1994, Rizzo also completed a *Comprehensive Solid Waste Site Assessment* for the Old Landfill Area. The assessment included completing a soil gas survey, installation of six overburden monitoring wells, one soil gas extraction well, excavation of test pits, and the collection and analysis of soil, groundwater, and surface water samples.

In September 1994, Rizzo completed a Supplemental Investigation for Area 5, the Barrel Storage Area. Six soil borings were advanced along the perimeter of the Barrel Storage Area. Rizzo reported that two monitoring wells were installed in the Barrel Storage Area; however, there is no documentation of the location of one of the monitoring wells (RIZ-70). Soil samples from each of the soil borings and monitoring wells in the Barrel Storage Area were collected from greater than 2 ft below ground surface (bgs) and laboratory analyzed for VOCs (EPA Method 8010) [33, Table 2].

In December 1994, Rizzo prepared a *Human Health and Environmental Risk Characterization* report summarizing groundwater analysis for the area surrounding Building No. 14, in the vicinity of the former trichloroethane (TCA)/dichloromethane (DCM) ASTs. Rizzo reported the installation of eight additional monitoring wells (WP-1 through WP-8) inside of Building No. 14. It should be noted that Rizzo used the designations WP-1 through WP-4 for groundwater samples collected south of the landfill, as well as for groundwater samples collected in the basement of Building No. 14.

In September 1996, Rizzo completed a *Phase II Comprehensive Site Assessment Human Health and Environmental Risk Characterization* report. The report summarized the sampling activities conducted by Rizzo since 1991 and characterized the risk of the contaminants and the health effect to potential targets. Rizzo concluded that future exposures to the Barrel Storage Area should be limited [7, p. 57].

In 1997, Rizzo completed a *Corrective Action Design-Alternative Landfill Final Cover System* for the Old Landfill Area located on the American Optical Co. property. Closure plans included temporary and permanent control measures, including installation of a gas venting system, a 12-inch clay layer, a 6-inch drainage layer, and a 6-inch vegetative support layer [25, p. 13].

Future plans for the property include the transfer of 12 of the on-site buildings located on the land west of the Quinebaug River to the U.S. Department of Defense (DOD) Center for Financial Management Education and Training (CFMET). The facility will be equipped with facility housing, a 316-room hotel, and a child-care center [7, p. 6].

At the request of EPA, this SIP has not included access to all on-site buildings and has focused on sources attributable to previous processes conducted on the American Optical Co. property without adding new potential sources attributed to companies leasing buildings from SALP [34].

Table 3 presents identified structures or areas on the American Optical Co. property that are documented or potential sources of contamination, the containment factors associated with each source, and the relative location of each source.

Table 3
Source Evaluation for American Optical Co.

| Source Area | Containment Factors | Spatial Location |
|---|----------------------------|-----------------------------------|
| Transformers | None | Throughout the property |
| Wastewater Treatment Plant Contaminated Soil | None | Southeast portion of the property |
| Wastewater Treatment Plant Associated Lagoons | None | Southeast portion of the property |
| Building No. 5 ASTs [One 3,500- gallon aboveground storage tank (AST) and one 1,500-gallon AST] | None | Central portion of the property |
| Former Wastewater Treatment Plant (Building No. 16) 55-gallon drums | Inside a concrete building | Central portion of the property |
| Powerhouse (55-gallon waste-oil drums) | Inside a concrete building | Central portion of the property |
| Powerhouse underground storage tanks (USTs) | None | Central portion of the property |
| Tank Farms (Nos. 1 and 2) | None | Central portion of the property |

Table 3

Source Evaluation for American Optical Co. (Continued)

| Source Area | Containment Factors | Spatial Location |
|---|---|--------------------------------------|
| 1,500-gallon Waste Oil AST | None | Central portion of the property |
| Two 500-gallon TCA and two 500-gallon DCM ASTs (formerly located east of Building No. 14) | None | Northeastern portion of the property |
| Historic Product USTs (formerly located throughout the property) | None | Throughout the property |
| Two 500-gallon ASTs (located adjacent to Building No. 2-L) | None | Southern portion of the property |
| Two Former Methyl Methacrylate UST (Building Nos. 24, 27, and 30) | None | Northwestern portion of the property |
| 4,000-gallon gasoline UST, (Building Nos. 24, 27, and 30) | None | Northwestern portion of the property |
| Oil House (Building No. 42 and associated 300-gallon AST) | Inside a concrete building | Central portion of the property |
| Incinerator (and associated ASTs) | None | Central portion of the property |
| Old Landfill Area | Maintained clay/fill cover | Southeastern portion of the property |
| American Optical (AO) Ballfield Landfill | None | Northwest portion of the property |
| Drum Storage Area | Impervious surface consisting of a liner with concrete covering | Southeastern portion of the property |
| Research Facility (Building No. 17) | Inside a concrete building | Southern portion of the property |
| Former Injection Molding Plant (Building No. 48) | Inside a concrete building | Southern portion of the property |
| Flammable Liquid Storage Area (Building No. 7-L) | Inside a concrete building | Southern portion of the property |
| Building No. 40 Storage | Inside a concrete building | Northwestern portion of the property |
| Vehicle and Ground Services (Building Nos. 24, 27, and 30) | Inside a concrete building | Northwestern portion of the property |
| PVC Silos | None | Northwestern portion of the property |
| Building No. 8 AST and Sump | Inside a concrete building | Northwestern portion of the property |

Table 3**Source Evaluation for American Optical Co. (Concluded)**

| Source Area | Containment Factors | Spatial Location |
|--------------------------------|----------------------------|----------------------------------|
| Building No. 5-L and 3-L drums | None | Southern portion of the property |
| Building No. 3-L AST | Inside a concrete building | Southern portion of the property |
| Fire Extinguishers | Inside concrete buildings | Throughout the property |

TCA = Trichloroethane
 DCM = Dichloromethane

[9; 11; 12; 13; 18]

Table 4 summarizes the types of potentially hazardous substances which have been disposed, used, or stored on the American Optical Co. property.

Table 4**Hazardous Waste Quantity for American Optical Co.**

| Substance | Quantity or Volume/Area | Years of Use/Storage | Years of Disposal/Release | Source Area |
|--|---|---|---|---|
| PCB | 125 gallons* | Unknown | Unknown | Transformers |
| Iron oxide and emery (aluminum oxide) sludge | 20,000 ft ² * | 1968 to Present | 1968 to unknown | Wastewater Treatment Plant Contaminated Soil |
| Wastewater; possibly VOCs and metals | Two lagoons × 100 ft × 150 ft | 1968 to Present | 1968 to Present | Wastewater Treatment Plant Associated Lagoons |
| Flocculation chemicals | One 3,500-gallon AST and one 1,500-gallon AST | 1968 to Present | 1968 to Present | Building No. 5 ASTs (One 3,500-gallon AST and one 1,500-gallon AST) |
| Heavy metals | Unknown | Unknown to 1987 | Unknown to 1987 | Former Wastewater Treatment Plant (Building No. 16) 55-gallon drums |
| Waste oil | 20 55-gallon drums | Unknown to Present | Unknown to Present | Powerhouse (55-gallon waste-oil drums) |
| Unknown | 20,000 gallons | Unknown to 1997 | Unknown to 1997 | Powerhouse USTs |
| Fuel oil | 960,000 gallons | Early 1900s to present (No. 1), and unknown to 1988 (No. 2) | Early 1900s to present (No. 1), and unknown to 1988 (No. 2) | Tank Farms (No. 1 and No. 2) |

Table 4

Hazardous Waste Quantity for American Optical Co. (Continued)

| Substance | Quantity or Volume/Area | Years of Use/Storage | Years of Disposal/ Release | Source Area |
|--|--|-------------------------------|-------------------------------|---|
| Waste oil | 1,500 gallons | Unknown to 1988 | Unknown to 1988 | 1,500-gallon Waste Oil AST |
| TCA and DCM | 2,000 gallons | Unknown to 1988 | Unknown to 1988 | Two 500-gallon TCA and two 500-gallon DCM ASTs (formerly located east of Building No. 14) |
| Petroleum products, benzene, and naphtha | Unknown | Early 1900s to Unknown | Early 1900s to Unknown | Historic Product USTs (formerly located throughout the property) |
| DCM | 1,000 gallons | 1988 to 1993 | 1988 to 1993 | Two 500-gallon ASTs (formerly located adjacent to Building No. 2-L) |
| Methyl methacrylate | One 4,000-gallon AST, one 1,500-gallon-AST | Unknown to 1988 | Unknown to 1988 | Two Former Methyl Methacrylate UST (Building Nos. 24, 27, and 30) |
| Gasoline | 4,000 gallons | 1988 to Present (unconfirmed) | 1988 to Present (unconfirmed) | 4,000-gallon gasoline UST, (Building Nos. 24, 27, and 30) |
| Unknown hazardous waste | 300 gallons | Unknown | Unknown | Oil House (Building No. 42 and associated 300-gallon AST) |
| Production waste | Unknown | 1971 to 1981 | 1971 to 1981 | Incinerator (and associated ASTs) |
| Unknown wastes | 268,201 ft ² * | 1907 to 1992 | 1907 to 1992 | Old Landfill Area |
| Unknown wastes | 1,085,400 ft ³ * | 1978 to Present | 1978 | AO Ballfield Landfill |
| Process wastes (Contaminated Soil) | 17,600 ft ² * | 1974 to Present | 1974 to early 1990s | Drum Storage Area |
| Unknown hazardous waste | Unknown | Unknown | Unknown | Research Facility (Building No. 17) |
| Lubricating and hydraulic oil | Unknown | Unknown | Unknown | Former Injection Molding Plant (Building No. 48) |

Table 4

Hazardous Waste Quantity for American Optical Co. (Concluded)

| Substance | Quantity or Volume/Area | Years of Use/Storage | Years of Disposal/Release | Source Area |
|-----------------------------|-------------------------|---|---|--|
| Flammable liquids | Unknown | Unknown | Unknown | Flammable Liquid Storage Area (Building No. 7-L) |
| IPP, acrylic crystals | Unknown | Unknown | Unknown | Building No. 40 Storage |
| Herbicides and pesticides | Unknown | Unknown | Unknown | Vehicle and Ground Services (Building Nos. 24, 27, and 30) |
| Vinyl chloride | Unknown | Unknown | Unknown | Polyvinyl Chloride Silos |
| Methylene chloride | 275 gallons | Connected from late 1970s to present (no longer used) | Connected from late 1970s to present (no longer used) | Building No. 8 AST and Sump |
| Oil/water and sulfuric acid | Seven 55-gallon drums | Unknown | Unknown | Building No. 5-L and 3-L drums |
| Sludge | 10,000 gallon | Unknown | Unknown | Building No. 3-L AST |
| Type A, B, and C | 400 pounds* | Unknown | Unknown | Fire Extinguishers |

PCB = Polychlorinated Biphenyl

TCA = Trichloroethane

DCM = Dichloromethane

AST = Aboveground Storage Tank

UST = Underground Storage Tank

AO = American Optical

PVC = Polyvinyl Chloride

* = Estimated by START based on field observations and historic data and is for the purpose of this report only

ft² = square feetft³ = cubic feet

[9; 11; 12; 13; 18]

There are no known additional CERCLA properties located within 1-radial mile of the American Optical Co. property. However, there are 27 RCRA properties located in Southbridge, Massachusetts. No National Priority List (NPL) properties are located in Southbridge, Massachusetts [16; 32].

WASTE/SOURCE SAMPLING

Prior to 1988, two USTs (a 4,000-gallon UST and a 1,500-gallon UST) were located in the facility garage area (Building Nos. 24, 27, and 30). These USTs were used to supply gasoline to the company vehicles. In June 1988, the 4,000-gallon tank failed the petro-tite leak test, and both tanks were removed. New England Industrial Waste, Inc. (NEIW) reported that stained soil was observed around the 1,500-gallon UST. After the tank removal, polymerized acrylic was observed on the inside surfaces of the tanks [11]. Approximately 80 yd³ of soil were removed from the area of the leaking UST. On 13 October 1988, NEIW collected eight soil samples from the sides of the excavation. The samples were analyzed for VOCs and methyl methacrylate via EPA Method 8240. Ethyl benzene at 0.03 parts per billion (ppb), total xylenes at 0.8 ppb, 1,1,1-trichloroethane (1,1,1-TCA) at 0.12 ppb, and 1,2-dichloroethylene (1,2-DCE) at 0.04 ppb were detected in one of the eight samples analyzed. Total xylene (0.08 ppb) was also detected in one of the other eight samples. Both of these samples were collected from the excavation area, below the groundwater table [15, App. C].

As part of the 1990 Phase I investigation, Rizzo collected four soil samples (S8-1 through S8-4) southeast of Building No. 48 in the area of Tank Farm No. 2. The depths of the samples and the laboratory data were not documented in the data provided to START. However, Rizzo reported that the soil samples contained TPH at concentrations of 930, 26,000, and 93 parts per million (ppm). According to Rizzo, no VOCs were detected in any of the four soil samples analyzed [9, p. 47].

In September and October 1990, as part of the Phase I Addendum 1 follow-up investigation, Rizzo completed three test pit excavations (L-1, L-2, and L-8) in Cell No. 1 of the Old Landfill Area, two test pit excavations in Cell No. 2 of the Old Landfill Area (L-3 and L-4), and three test pit excavations (L-5, L-6, and L-7) in Cell No. 3 [21, p. 7]. Rizzo also excavated three test pits (P-1 through P-3) in the parking area southwest of the landfill (Tank Farm No. 2). Reportedly, the fill in the excavations was comprised of fine sand to fine gravel, ash, metal scrap, pitch, glass, red and green polishing compounds, fire brick, and paper. Rizzo reported that the excavation was completed to a depth of approximately 9 ft but had not reached the lower limit of the fill material [21, p. 7]. Soil samples were collected at undocumented depths from L-2 (with L-2 duplicate), L-4 (with L-4 duplicate), L-6, and P-1 through P-3, and were analyzed through a private laboratory for VOCs, pesticides/PCBs, PPL metals, and TPH utilizing EPA Method 8240, EPA Method 8080, and EPA Methods 6,000 and 7,000 series, respectively. Soil samples collected from P-1 through P-3 were also analyzed for cyanide. No PCBs were detected in the samples. Toluene was present in L-2 and L-6 at 1,200 ppb and 510 ppb, respectively. PPL metals were present in the samples collected from L-2, L-4, and L-6 ranging in concentrations from 5.2 ppm (silver) to 8,080 ppm (lead), with the highest concentrations detected in L-4. PPL metals were present in the P-1 through P-3 samples ranging in concentrations from 0.99 ppm (mercury) to 19,500 ppm (lead), with the highest concentration detected in P-2. TPH was present in all the samples collected with the exception of P-3 [21, Table 5]. No reference sample has been identified for the soil/source samples.

In March 1991, Rizzo installed 14 soil borings (RIZ-41, RIZ-43, RIZ-44, and RIZ-46 through RIZ-56) to approximately 7 ft bgs. Rizzo collected and submitted a subsurface soil sample from soil boring RIZ-42 to a private laboratory for VOCs (EPA Method 8240), TPH (infrared spectrometry), total RCRA 8 metals, base/neutral and acid extractables (BNAs) including PCBs and pesticides (EPA Method 8250), and total cyanide analyses. Rizzo reported that no VOCs, BNAs, pesticides, PCBs, or cyanide were detected in the sample. However, TPH and five RCRA metals were detected. TPH was detected at 235 ppm. Arsenic (4.5 ppm), barium (86.9 ppm), cadmium (1.2 ppm), chromium (67 ppm), and lead (19.9 ppm) were also detected in the sample. No reference sample was analyzed for the sampling event [27, p. 9].

In July 1991, Rizzo collected soil samples from the vicinity of Building No. 48, where stained soil was visually observed. The source of the staining was reported to be from a discharge pipe, which lead from the truck ramp at the loading dock of Building No. 48 to an unspecified location. The exact location and depths of the soil samples collected is not documented. Soil samples were analyzed for VOCs and TPH by a private laboratory utilizing EPA Methods. Rizzo reported that no VOCs were detected, but TPH was detected ranging in concentrations from 22,080 ppm to 27,270 ppm [29, p. 3].

In June 1994, Rizzo completed a *Phase II Comprehensive Site Assessment Report*. As part of the assessment, a soil gas survey was conducted in the region of the Barrel Storage Area. Rizzo utilized a 50 Gore-Sorber Screening Modules for the survey, in order to detect the presence of VOCs and SVOCs. Rizzo reported that numerous VOCs including benzene, toluene, ethylbenzene, xylenes, and naphthalene were detected via the soil gas survey [2, p. 23].

Also in June 1994, Rizzo advanced two soil borings (SB-1 and SB-2) in the area of the former TCA/DCM ASTs at Building No. 14. Surficial soil samples were collected from SB-01 and SB-02 at depths ranging from 0 to 1 ft, 1 to 2 ft, and 2 to 3 ft and analyzed for VOCs via EPA Method 8260 and TPH via EPA Method 8100 [2, p. 29, Table 6-1]. Trichloroethylene (TCE), tetrachloroethylene (PCE), 1,1,1-TCA, 1,1,2-trichloroethane (1,1,2-TCA), and cis-1,2-DCE were detected in the samples at concentrations ranging from 8.3 to 150 ppb [2, Table 6-1].

Also in June 1994, Rizzo completed a *Comprehensive Solid Waste Site Assessment* for the Old Landfill Area. The assessment included a soil gas survey, installation of six overburden monitoring wells (RIZ-61, and RIZ-64 through RIZ-68), one soil gas extraction well (RIZ-60), and the excavation of test pits (TP-1 through TP-3). Rizzo collected soil samples from each monitoring well during installation and analyzed the samples for VOCs. Summary tables produced by Rizzo indicate that the following VOCs were detected in at least one of the samples: TCE, PCE, 1,1,1-TCA, cis-1,2-DCE, trans-1,2-DCE, 1,1-dichloroethane (1,1-DCA), methylene chloride, 4-methyl-2-pentanone, 2-butanone, benzene, toluene, ethyl benzene, xylenes and acetone ranging in concentrations from 9.7 ppb (TCE in RIZ-66) to 12,000 ppb (TCE in RIZ-65) [22, Table 8].

In September 1994, Rizzo completed a *Supplemental Investigation for Area 5*, the Barrel Storage Area. Six soil borings (SB-3 through SB-8) were advanced along the perimeter of the Barrel Storage Area. Monitoring wells were installed in each of the soil borings. During monitoring

well installation, soil samples were screened for VOCs utilizing a PID. Soil samples were collected at depths greater than 2 ft from each of the eight locations during installation, and were analyzed for VOCs via EPA Laboratory Method 8010. Soil boring SB-5 is located upgradient of the Barrel Storage Area, and for the purposes of this report, is used as a reference sample. TCE, PCE, 1,1,1-TCA, cis-1,2-DCE, and 1,1-DCA were detected in SB-8 and RIZ-69 at concentrations ranging from 9.0 ppb to 1,900 ppb. One or more of the following VOCs were detected in SB-3, SB-4, and SB-7: TCE, 1,1,1-TCA, and cis-1,2-DCE [33, Table 2].

GROUNDWATER PATHWAY

Overburden materials on the American Optical Co. property consist of clay to boulder-sized glacial till material. Surficial soil on the northwestern portion of the property, west of the Quinebaug River, consists of ash, sand, gravel, and debris to a depth of approximately 5 ft [9, p. 31]. The bedrock in the area surrounding the American Optical Co. property is of the Paxton Formation, primarily composed of undifferentiated biotite granofels, calc-silicate granofels, and sulfitic schist [38]. There are bedrock outcrops on several areas of the property [9, p. 31]. The depth to bedrock ranges from approximately 0 to 7.5 ft bgs on the property [27, p. 21].

Groundwater beneath the property flows to the south-southeast, and discharges to the Quinebaug River [9, p. 32]. The depth to groundwater beneath the property is between 1 and 12 ft bgs [9, Table 4]. The annual precipitation rate for the Southbridge area is 48.84 inches [39].

A 4-radial mile distance ring, from the border of the American Optical Co. property, includes portions of both Massachusetts and Connecticut. Portions of the Massachusetts towns located within 4-radial miles of the American Optical Co. property include Southbridge (population 30,469), Charlton (population 9,371), Dudley (population 8,955), and Sturbridge (population 9,810) [28]. A portion of Woodstock, Connecticut (population 6,008) is also located within 4-radial miles of the American Optical Co. property [1; 58].

Approximately 17,500 Southbridge residents are served by surface water intakes from five surface water reservoirs located between 3 and 5 miles southwest of the American Optical Co. property (these reservoirs are not located on the American Optical Co. 15-mile downstream surface water pathway). Residents of Charlton and Sturbridge are also supplied by the Southbridge surface water reservoirs. The remaining residents of Southbridge rely on private wells [40].

The populations of Charlton, Massachusetts and Woodstock, Connecticut are entirely supplied with drinking water from private groundwater supply wells [41; 42].

The residents of Dudley are supplied with drinking water from three public groundwater supply wellfields located beyond 4-radial miles from the American Optical Co. property [43].

Approximately 1,250 Sturbridge residents are supplied by two equally blended gravel-packed wells (Well Nos. 2 and 3), located approximately 3.8 miles northeast of the American Optical Co. property. Water pumped from the wells is filtered in a treatment plant prior to distribution. A third gravel-packed well (Well No. 1), located approximately 100 ft north of Well Nos. 2 and 3,

is used only as emergency backup due to benzene contamination. The detection of benzene in Well No. 3 is not likely attributable to the American Optical Co. property since groundwater beneath the American Optical Co. property flows south-southeast. The remaining population of Sturbridge is supplied with drinking water from private supply wells [44]. Table 5 summarizes the public groundwater supply sources located within 4-radial miles of the American Optical Co. property.

Table 5

Public Groundwater Supply Sources Within 4-Radial Miles of American Optical Co.

| Distance/Direction from American Optical Co. | Source Name | Location of Source ^a | Estimated Population Served | Source Type ^b |
|--|-------------|---------------------------------|-----------------------------|---------------------------|
| 3.8 miles northeast | Well No. 2 | Sturbridge | 625 | Overburden: Gravel-packed |
| 3.8 miles northeast | Well No. 3 | Sturbridge | 625 | Overburden: Gravel-packed |

^a Indicates Town in which well is located.

^b Overburden, Bedrock, or Unknown.

[44]

The location of the nearest private well is unknown; however, it is estimated to be located within 0 to 0.25-radial miles of the American Optical Co. property [40]. Private groundwater supplies located within 4-radial miles of the American Optical Co. property were estimated using equal distribution calculations of U.S. Census CENTRACTS data identifying population, households, and private water wells for "Block Groups" which lie within or partially within individual radial distance rings measured from the American Optical Co. property. Almost the entire area within the 4-radial miles from American Optical Co. lies within Massachusetts. However, a small portion of the 3- to 4-radial mile ring is located within Connecticut. The total population (Massachusetts and Connecticut) which relies on groundwater (public and private) within 4-radial miles of the property is estimated at 6,288 persons. Of this population, an estimated 5,038 people are served with drinking water from private drinking water wells. Table 6 summarizes the estimated population served by groundwater sources within 4-radial miles of the American Optical Co. property.

Table 6

**Estimated Drinking Water Populations Served by Groundwater Sources
Within 4-Radial Miles of American Optical Co.**

| Radial Distance from American Optical Co. (miles) | Estimated Population Served by Private Wells | Estimated Population Served by Public Wells | Total Estimated Population Served by Groundwater Sources Within the Ring |
|---|--|--|---|
| ≥ 0.00 to 0.25 | 20 | 0 | 20 |
| > 0.25 to 0.50 | 36 | 0 | 36 |
| > 0.50 to 1.00 | 114 | 0 | 114 |
| > 1.00 to 2.00 | 706 | 0 | 706 |
| > 2.00 to 3.00 | 1917 | 0 | 1917 |
| > 3.00 to 4.00 | 2245 | 1250 | 3495 |
| TOTAL | 5038 | 1250 | 6288 |

[44; 45]

On 8 March 1990, Rizzo completed a *Phase I Limited Site Investigation* report for the American Optical Co. property. As part of the investigation, Rizzo installed a total of 27 monitoring wells (RIZ-1 through RIZ-20, and RIZ-22 through RIZ-28). Twenty-two wells were installed in overburden, and five wells were installed in bedrock (RIZ-14, RIZ-15, RIZ-20, RIZ-25, and RIZ-26). Rizzo collected split spoon soil samples at 5-ft intervals from the monitoring wells during installation. The soil samples collected from each monitoring well were field-screened with a PID with a 10.2 electron volt (eV) lamp. Soil samples collected from RIZ-6, RIZ-12, RIZ-17, RIZ-18, and RIZ-26 recorded PID readings of greater than 1 ppm above background. A total of three rounds of groundwater sampling of the monitoring wells was conducted during the Phase I investigation. Initially, Rizzo installed RIZ-1 through RIZ-20, and RIZ-22 through RIZ-24, and collected a groundwater sample from each well between 10 and 12 October 1989. On 3 November 1989, another groundwater sample was collected from RIZ-15. On 31 January 1990, four additional monitoring wells were installed (RIZ-25 through RIZ-28) and sampled along with surrounding Rizzo wells [9, pp. 32-33]. Groundwater samples were field-screened with a PID. PID readings of at least 1 ppm above background were recorded for 10 of the screened groundwater samples. The samples collected from the second and third sampling rounds were submitted to a laboratory for analysis [9, pp. 30, 36-38].

Groundwater samples collected in October 1989 from RIZ-1, RIZ-2, RIZ-5, RIZ-6, RIZ-6 (duplicate), RIZ-8, RIZ-9, RIZ-14, RIZ-15, RIZ-16, RIZ-17, RIZ-19, and RIZ-25 through RIZ-28 were submitted to Alpha Analytical Laboratories for analyses. The groundwater sample collected from monitoring well RIZ-15 in November 1989, and the groundwater samples collected from RIZ-5, RIZ-7, RIZ-14, and RIZ-15 in January 1990, were also submitted to Alpha Analytical

Laboratories for analyses. The analytical methods used by Alpha Analytical Laboratories for analyses included the following: VOCs (EPA Method 8240), pesticides/PCBs (EPA Method 8080), PPL metals (EPA Method 6,000 and 7,000 series), and TPH (EPA Method 503BE) [9, App. D].

During the October 1989 sample round, selected groundwater samples collected by Rizzo were analyzed for VOCs, PCBs/pesticides, TPH, and PPL metals. Groundwater samples collected from RIZ-2, RIZ-5 through RIZ-9, RIZ-14 through RIZ-17, and RIZ-19 were analyzed for VOCs. Groundwater samples collected from RIZ-6, RIZ-7, RIZ-11, RIZ-12, RIZ-16, RIZ-17, and RIZ-23 were analyzed for PCBs. All groundwater samples collected in the October 1989 sampling round were analyzed for TPH. Groundwater samples collected from RIZ-1, RIZ-2, RIZ-5 through RIZ-7, RIZ-15, RIZ-16, and RIZ-18 were analyzed for PPL metals. The groundwater sample collected from RIZ-15 in November 1989 and the groundwater samples collected in January 1990 from RIZ-15 and RIZ-25 through RIZ-28 were analyzed for VOCs [9, Table 7; App. D].

START evaluated the presence of compounds from Rizzo sampling rounds based on re-evaluation of laboratory data and Quality Assurance/Quality Control (QA/QC) criteria. A compound "detected" in a sample is defined as a compound present in a sample at least three times the reference concentration or greater than or equal to the reference sample's sample quantitation limit (SQL).

Based on START data evaluation of the October 1989 sample round, VOCs were detected in RIZ-6 and RIZ-6 (duplicate), using RIZ-5 (screened in overburden) collected from the same sampling round as a reference. VOCs were also detected in RIZ-19 of the October 1989 sampling round by using RIZ-9 (screened in overburden) collected from the same sampling round as a reference. VOCs were detected in RIZ-6, RIZ-6 (duplicate), and RIZ-27 from the January 1990 sampling round, using RIZ-5 (screened in overburden) collected from the same sampling round as a reference, and in RIZ-14, RIZ-15, and RIZ-26 using RIZ-25 (screened in bedrock) collected from the January 1990 sampling round as a reference.

The highest concentrations and quantity of VOCs detected in the November 1989 and January 1990 sampling rounds occurred in monitoring wells RIZ-6 and RIZ-15. Samples collected from RIZ-6 contained all 10 VOCs analyzed for [1,1-dichloroethylene (1,1-DCE); 1,1-DCA; chloroform; TCE; 1,1,2-TCA; PCE; 1,2-DCE; 1,2-dichloroethane (1,2-DCA); 1,1,1-TCA; and toluene] at concentrations ranging from 2.0 ppb to 13,000 ppb. Samples collected from RIZ-15 contained TCE ranging from 2,300 ppb to 16,000 ppb, and 1,2-DCE ranging from 13 to 17 ppb. All monitoring wells that were resampled in January 1990 indicated a decline in VOC concentrations. TPH and metals were present at varying concentrations throughout most of the monitoring wells; however, the levels were below or equal to the maximum contaminant level (MCL) with the exception of arsenic, detected in monitoring well RIZ-6 and RIZ-6 (duplicate) at 0.006 and 0.009 ppb, respectively. The MCL for arsenic is 0.05 ppm [9, Table 7]. No PCBs were detected in the monitoring wells sampled during these sampling rounds [9, App. D].

The elevated levels of VOCs detected in the October 1989 Phase I groundwater sampling round were detected in the region of the former TCA/DCM ASTs outside of Building No. 14 (RIZ-6 and

RIZ-27), the oil house (Building No. 42)/Building No. 18 area (RIZ-15 and RIZ-26), the Barrel Storage Area (RIZ-19), and the area surrounding Building No. 16 (RIZ-9 and RIZ-14) [9, Figure 4].

In October 1990, Rizzo reported the advancement of nine soil borings. However, in the summary of laboratory data, Rizzo documented 10 soil borings (RIZ-29 through RIZ-38). Eight of these soil borings were completed as monitoring wells (RIZ-29 through RIZ-35, and RIZ-38) [21, Table 6]. Monitoring wells RIZ-29 through RIZ-31 were advanced to further characterize contamination from the drum storage area. Monitoring wells RIZ-32 through RIZ-35, and RIZ-38 were advanced to further assess contamination from the landfill and lagoon area. Monitoring wells RIZ-36 and RIZ-37 were advanced in the parking lot area to assess the extent of the contaminated fill [21, pp. 10, 11]. Groundwater samples were collected from these wells in October 1990. Rizzo did not document which of the existing monitoring wells were sampled in fall 1990; however, analytical data are provided for an October 1990 sampling round that includes water samples collected from RIZ-16, RIZ-18 through RIZ-20, and RIZ-29, through RIZ-35 (with duplicate samples collected at RIZ-29 and RIZ-32) [21, Table 6].

The October 1990 groundwater samples were analyzed for VOCs (EPA Method 8240), TPH (EPA Method 6,000 and 7,000 series), and PPL metals (EPA Method 503BE) [21, App. D]. Additionally, groundwater samples collected from RIZ-16, RIZ-18 through RIZ-20, RIZ-29, and RIZ-30 were analyzed for cyanide. Since no information was available regarding the material (overburden or bedrock) in which RIZ-35 was screened, monitoring well RIZ-34 (screened in overburden) was used as an upgradient reference. No cyanide was detected in any of the samples. However, groundwater analytical results indicated elevated levels of one or more of the following VOCs: PCE, 1,1,1-TCA, cis-1,2-DCE, TCE, toluene, vinyl chloride, and chloroform. These VOC concentrations ranged from 4.6 ppb to 9,400 ppb at the following sample locations: RIZ-29 (and RIZ-29 duplicate), RIZ-19, RIZ-30 through RIZ-32 (and RIZ-32 duplicate), and RIZ-35. Elevated concentrations of TPH were detected in RIZ-16 and RIZ-32. Elevated concentrations of PPL metals, including cadmium, copper, lead, mercury, and zinc were detected in RIZ-32 (and RIZ-32 duplicate) [21, Table 6].

In March 1991, Rizzo advanced four additional monitoring wells (RIZ-39, RIZ-40, RIZ-42, RIZ-45) in the area east of Building No. 48. The exact locations of the wells were not documented in the Rizzo report [27]. During well installation, soil samples were screened for VOCs utilizing a PID. A soil sample collected from 5 to 7 ft from monitoring well RIZ-42 was submitted for laboratory analysis for VOCs (EPA Method 8240), TPH (infrared spectroscopy), RCRA-8 metals, SVOCs, PCBs/pesticides (EPA Method 8250), and cyanide. No elevated levels of VOCs, SVOCs, PCBs/pesticides, or cyanide were detected in the sample. However, elevated levels of TPH and 5 RCRA metals were detected. TPH was present at 235 ppm. Arsenic, barium, cadmium, chromium, and lead were also detected at concentrations ranging from 1.2 ppm to 86.9 ppm. No reference sample was identified for the sampling event [27, p. 9].

On 10 March 1991, Rizzo collected groundwater samples from monitoring wells RIZ-15, RIZ-25, RIZ-26, RIZ-39, RIZ-40, RIZ-42, and RIZ-45. The samples were analyzed for VOCs (EPA Method 8260), soluble RCRA-8 metals (EPA Method 6000 and 7000 series), TPH (EPA Method

5520-CDF), and total cyanide (EPA Method 4500-CN-CE). Additional groundwater samples were collected from RIZ-38 (analyzed for VOCs and TPH) and RIZ-32 (analyzed for VOCs) in May 1991. Although RIZ-45 is screened in overburden, for the evaluation purposes, RIZ-25 (screened in bedrock) is used as a reference because no upgradient overburden reference samples were collected. Analytical results indicate that elevated VOCs were detected at RIZ-15 (TCE and 1,2-DCE), RIZ-26 (TCE), and RIZ-38 (TCE, 1,1-DCE, and 1,2-DCE) ranging in concentrations from 4.8 to 2,300 ppb. Zinc was detected in RIZ-45 at 0.01 ppm [27, Table 6]. The location of monitoring well RIZ-42 is unknown [2, Figure 2]. The locations of the other monitoring wells are depicted on Figure 2.

In August 1991, Rizzo submitted a *Notice of Deficiency Response* for American Optical Co. As part of the evaluation, Rizzo collected groundwater samples from RIZ-3, RIZ-4, RIZ-10 through RIZ-13, RIZ-22, and RIZ-23. Groundwater samples were laboratory analyzed for VOCs utilizing EPA Laboratory Method 8260. VOCs were present in monitoring wells RIZ-3 and RIZ-13; however, no reference sample was collected to quantify the extent of contamination [29, Table 2].

In June 1994, Rizzo completed a *Phase II Comprehensive Site Assessment Report* for American Optical Co. A soil gas survey was conducted on the soil in the region of the Barrel Storage Area utilizing a 50 Gore-Sorber Screening Modules to detect the presence of VOCs and SVOCs. Rizzo reported that the soil gas survey indicated that numerous VOCs, including benzene, toluene, ethylbenzene, xylene, and naphthalene, were present in on-site soil [2, p. 23]. As part of the Phase II investigation, additional soil borings were advanced and five additional monitoring wells were installed, identified as RIZ-57 through RIZ-59, RIZ-62, and RIZ-63. Soil samples were collected at 5-foot intervals and screened for VOCs utilizing a PID during the installation of the monitoring wells and the advancement of soil borings. Monitoring well RIZ-57 was advanced in the area of the former TCA/DCM ASTs at Building No. 14. Monitoring well RIZ-57 was advanced to a depth of 55 ft, in order to define the vertical extent of contamination [2, p. 25]. Monitoring well RIZ-62 was advanced to a depth of 53 ft in the vicinity of Building No 18. Monitoring well RIZ-58 was advanced to a depth of 15 ft in the vicinity of Building No. 48. Monitoring wells RIZ-59 and RIZ-63 were advanced to depths of 31 ft and 16 ft, respectively, in the Barrel Storage Area [2, p. 26].

Rizzo reported that on 30 November 1993 and 2 December 1993, groundwater samples were collected from RIZ-57 through RIZ-59, RIZ-62, RIZ-63, and a select group of previously existing monitoring wells. The groundwater samples collected from RIZ-57, RIZ-58, RIZ-59, and RIZ-63 were analyzed for VOCs (EPA Method 8260) [2, p. 29]. RIZ-57 and RIZ-58 were also analyzed for TPH (EPA Method 8100). No reference sample was collected for comparison. In the Phase II evaluation completed by Rizzo, laboratory data from a 12 October 1993 sampling round (not documented in text, however, analytical data from groundwater samples collected for the Phase II report from RIZ-57 through RIZ-59, and RIZ-63) were included in the analytical section of the document [2, Table 6-1]. Rizzo reported that the groundwater samples collected and analyzed for VOCs were from the following wells: RIZ-3 through RIZ-7, RIZ-10, RIZ-12 through RIZ-16, RIZ-19, RIZ-25 through RIZ-31, RIZ-38, RIZ-45, RIZ-57 through RIZ-59, RIZ-62, and RIZ-63 [2, Table 6-2]. On the western side of the Quinebaug River, VOCs were detected in the groundwater samples collected from RIZ-6, RIZ-27, and RIZ-28, using RIZ-5 (screened in

overburden) as a reference. On the eastern side of the Quinebaug River, VOCs were detected in RIZ-10, RIZ-13, RIZ-16, RIZ-19, and RIZ-59, using RIZ-45 (screened in overburden) as a reference sample [2, Table 6-2]. VOCs were detected in RIZ-14, RIZ-15, RIZ-26, RIZ-38, RIZ-58, RIZ-62, and RIZ-63, using RIZ-25 (screened in bedrock) as a reference. In an effort to identify the reference sample used for comparison for each aquifer type, the reference samples for the overburden groundwater aquifer and the bedrock groundwater aquifer were determined/chosen by START based on the location of the wells, the screened matrix of each well, and the contaminant concentrations identified in each well. Additionally, since the Quinebaug River may serve as a hydrogeologic barrier, START evaluated the data by dividing the property into areas isolated by the Quinebaug River (eastern and western sides) and determined reference samples for each area.

In June 1994, Rizzo completed a *Comprehensive Solid Waste Site Assessment* for the Old Landfill Area. The assessment included installation of six overburden monitoring wells (RIZ-61 and RIZ-64 through RIZ-68). As part of the assessment, in December 1993, Rizzo collected groundwater samples from RIZ-32 through RIZ-35, RIZ-61, RIZ-64 through RIZ-68, and four monitoring well points (WP-1 through WP-4) located along the Quinebaug River, south of the landfill. The samples were analyzed for VOCs utilizing EPA Method 8260 [7, pp. 10-14]. No laboratory data sheets were supplied by Rizzo for the above groundwater sampling event; however, summary tables provided by Rizzo indicate that one or more of the following VOCs were present in each of the groundwater samples collected from RIZ-32, RIZ-61 through RIZ-68, and WP-1: TCE; PCE; 1,1,2-TCA; 1,1,1-TCA; cis-1,2-DCE; trans-1,2-DCE; 1,1-DCE; chloroform; vinyl chloride; chloroethane; chlorobenzene; toluene; ethyl benzene; xylene; 2-butanone; 4-methyl-2-pentanone; methylene chloride; and acetone [22, Table 9].

In December 1994, Rizzo prepared a *Human Health and Environmental Risk Characterization* summarizing additional groundwater analysis for the area surrounding Building No. 14 (in the vicinity of the area of the former TCA/DCM ASTs). Rizzo reported the installation of eight well points (WP-1 through WP-8) inside of Building No. 14. This sample identification system (WP-X) overlaps well-point numbers (WP-1 through WP-4) with the samples collected south of the Old Landfill Area in June 1994. No laboratory data were available regarding the groundwater sampling of WP-1 through WP-4 south of the landfill. All data reported in the Rizzo 1994 report for WP-1 through WP-4 refers to the groundwater samples collected in the basement of Building No. 14. Well points WP-1 through WP-8 were sampled and analyzed for VOCs in August 1994 (EPA Method 8010), and again in September 1994 (EPA Method 8260). Monitoring well WP-7, located upgradient of WP-1 through WP-6, and WP-8, was selected by START as a reference sample for comparison purposes. VOCs were detected in WP-1 through WP-6, and in WP-8 in the August 1994 sampling round [31]. The September 1994 sample round analysis indicated elevated levels of VOCs were again detected in WP-1 through WP-6, and in WP-8 [31].

START did not perform groundwater sampling as part of the American Optical Co. SIP. Based on analytical results from previous monitoring well sampling events collected from the American Optical Co. property, groundwater beneath the property has been impacted by a release of hazardous substances which appears to be partially attributable to on-site sources. However, based on the location and proximity of the surrounding residential wells and since there are no analytical data to support contamination in the nearby residential wells, no nearby drinking water sources

are known or suspected to have been impacted by the release from on-site sources. Additionally, no known activities have been undertaken to remediate or reduce the effects of the release to groundwater.

SURFACE WATER PATHWAY

Surface water runoff from the majority of the American Optical Co. property flows directly into the Quinebaug River, which bisects the property. Runoff from the southeastern portion of the property (the Old Landfill Area and the on-site lagoons) flows to Rouge Brook, a small perennial stream located to the east of the lagoons that flows from north to south/southeast. Runoff flows approximately 0.1 miles through Rouge Brook and then discharges to the Quinebaug River. Rouge Brook and the Quinebaug River are both probable points of entry (PPEs) to the 15-mile downstream surface water pathway. The Quinebaug River flows approximately 5.5 miles to the West Thompson Reservoir. Surface water flow continues in the West Thompson Reservoir for approximately 1.5 miles, then flows the remaining 8 miles in the Quinebaug River to the end of the 15-mile downstream surface water pathway. The terminus of the 15-mile surface water pathway is located along the Quinebaug River in Putnam, Connecticut near US Geological Survey (USGS) gaging station 01124000, 15.0 downstream miles from the most upstream Quinebaug River PPE (Figure 3). Portions of the American Optical Co. property are located within the 100 year flood plain, while other areas are located within the 100 to 500 year flood plain [50].

START personnel estimated the flow rate of Rouge Brook by measuring the area of the drainage basin (in square miles) and multiplying the area by the USGS conversion factor of 1.8 cubic feet per second (cfs) per square mile. The mean annual flow rate of the Rouge Brook is estimated to be 0.4 cfs [59].

USGS had maintained a stream gaging station (No. 01123600) along the Quinebaug River, approximately 1 mile upstream of the American Optical Co. property, from 1962 to 1987. This gaging station is no longer operable, however the former flow rate recorded for the Quinebaug River was 171 cfs [51]. USGS has maintained an additional stream gaging station (No. 01124000) along the Quinebaug River (approximately 15 miles downstream of the American Optical Co. property) since 1932. The mean annual discharge for the Quinebaug River, recorded at this gaging station (No. 01124000) is 275 cfs [52]. START will consider the flow rate of the Quinebaug River along the segment of the 15-mile surface water pathway (including the West Thompson Reservoir) to be the mean annual flow rate of the two USGS gaging stations, 223 cfs. Table 7 summarizes the surface water bodies located along the 15-mile downstream surface water pathway from the American Optical Co. property.



USGS GAGING STATION
NO. 01123800
171 cfs

SOUTHBRIDGE TOWN SEWAGE
TREATMENT PLANT

AMERICAN OPTICAL CO.
PROPERTY

ROUGE BROOK
ESTIMATED FLOW RATE:
0.4 cfs

QUINEBAUG RIVER
ESTIMATED FLOW RATE:
223 cfs

WEST THOMPSON RESERVOIR
ESTIMATED FLOW RATE:
223 cfs

SOUTHBRIDGE

DUDLEY

THOMPSON

PUTNAM

ADAPTED FROM THE FOLLOWING USGS MAPS:
LEICESTER, MA, PUTNAM, CT, WEBSTER, MA, AND SOUTHBRIDGE, MA

15-MILE SURFACE WATER
PATHWAY TERMINUS

USGS GAGING STATION
NO. 01124000
275 cfs

NOT TO SCALE

LEGEND



SURFACE WATER



FISHERY

PROBABLE POINT OF ENTRY
AMERICAN OPTICAL CO. PROPERTY



GAGING STATION
SURFACE WATER
FLOW DIRECTION

cts



CUBIC FEET PER SECOND

WETLAND



TOWN BOUNDARY



STREAM/RIVER

SURFACE WATER PATHWAY SKETCH

AMERICAN OPTICAL CO.
14 MECHANIC STREET
SOUTHBRIDGE, MASSACHUSETTS



MANAGERS

DESIGNERS/CONSULTANTS

REGION I SUPERFUND TECHNICAL ASSESSMENT AND RESPONSE TEAM

TDO NO.
98-05-0089

DRAWN BY:
K. UMSTOT

DATE
10/27/97

FILE NAME:
S:\97060016\FIG3.DWG

FIGURE 3

Table 7

**Surface Water Bodies Located Along the 15-Mile Downstream Pathway from
American Optical Co.**

| Surface Water Body | Descriptor ^a | Length of Reach (miles) | Flow Characteristics (cfs) ^b | Length of Wetland Frontage (miles) |
|-------------------------|--------------------------|-------------------------|---|------------------------------------|
| Rouge Brook | Minimal Stream | 0.1 | 0.4 | 0.1 |
| Quinebaug River | Moderate to large stream | 5.5 | 223 | 4.5 |
| West Thompson Reservoir | Moderate to large stream | 7.0 | 223 | 0.8 |
| Quinebaug River | Moderate to large stream | 15.0 | 223 | 2.2 |

^a Minimal stream < 10 cfs. Small to moderate stream 10-100 cfs. Moderate to large stream > 100-1,000 cfs. Large stream to river > 1,000-10,000 cfs. Large river > 10,000-100,000 cfs. Very large river > 100,000 cfs. Coastal tidal waters (flow not applicable). Shallow ocean zone or Great Lake (flow not applicable). Moderate depth ocean zone or Great Lake (flow not applicable). Deep ocean zone or Great Lake (flow not applicable). Three-mile mixing zone in quiet flowing river 10 cfs or greater.

^b Cubic feet per second.

[1; 46-49; 52]

The Quinebaug River and West Thompson Reservoir are MA DEP designated Level B water bodies, indicating that they are habitats for fish, other aquatic life, wildlife, and may be used for recreational purposes [53]. No known surface water along the 15-mile downstream surface water pathway is utilized as a source for drinking water supplies [40-43].

EPA reports that there are two state-threatened species located approximately 1.6 miles from the American Optical Co. property [54]. There are an estimated 7.5 miles of wetland frontage along the 15-mile surface water pathway [56]. The Connecticut Department of Environmental Protection (CT DEP) reports that there are no occurrences of State- or Federal-endangered/threatened species located within the Connecticut portion of 4-radial miles from the American Optical Co. property, or along the 15-mile downstream surface water pathway [55]. Table 8 summarizes the sensitive environments located along the 15-mile downstream surface water pathway.

Table 8**Sensitive Environments Along the 15-Mile Downstream Pathway from
American Optical Co.**

| Sensitive Environment Name | Sensitive Environment Type | Surface Water Body | Downstream Distance from PPE (miles) | Flow Rate at Environment (cfs) ^a |
|----------------------------|----------------------------|--------------------|--------------------------------------|---|
| CWA | Clean Water Act | Rouge Brook | 0 | 0.4 |
| Wetlands | 0.1 miles Wetlands | Rouge Brook | 0 | 0.4 |
| Wetlands | 7.5 miles Wetlands | Quinebaug River | 0 | 223 |
| Plant | State-threatened | Quinebaug River | 1.6 | 223 |
| Plant | State-threatened | Quinebaug River | 1.6 | 223 |

PPE = Probable Point of Entry

CWA = Clean Water Act

^a Cubic feet per second

[54; 56]

American Optical Co. reported that Rouge Brook has previously contained residue iron oxide grinding compound formerly used by American Optical Co. The brook was once reported to be red, or rouge in color, possibly a result of the iron oxide discharge to the brook. The discharge of iron oxide by American Optical Co. to Rouge Brook discontinued in 1967 when the current wastewater treatment system was initially put into operation [2, p. 13]. Based on field observations, START members observed that Rouge Brook is likely to be receiving groundwater to surface water recharge from the two wastewater treatment lagoons [10, p. 13].

American Optical Co. operates an NPDES discharge under Permit No. MA0003361, issued in 1974, which allows discharge of non-contact cooling water, stormwater, and treated industrial wastewater in the Quinebaug River. Non-contact cooling waters are generated from on-site manufacturing processes and the powerhouse [2, p. 12]. American Optical Co. holds permits for and discharges at 10 NPDES permitted outfalls along the Quinebaug River. American Optical Co. is required to sample each discharge for pH, flow volume, and temperature on a monthly basis. Three of the outfalls are additionally sampled for chlorine, due to the use of chlorine as a disinfectant for the cooling waters [2, p. 12]. Based on sampling results, American Optical Co. has not reported a release of chlorine above permit levels [13].

In approximately 1968, American Optical Co. began operating a wastewater treatment plant in the southeastern corner of the property. Iron oxide and emery (aluminum oxide) sludge, which were the wastes produced by the facility at that time, was used as fill and diking material during the treatment plant construction [12]. In 1981, the wastewater treatment system reportedly received wastewater consisting of Serox and Super Cerite from the polishing processes conducted at the facility. In 1990, Rizzo reported that the treatment plant received wastewaters from the on-site

powerhouse (consisting of sand filter backwash and boiler blowdown waters), and the lens grinding and polishing operations. In 1990, the treatment plant was operating at 0.12 million gallons per day [12]. The treatment process utilized at the facility is a primary settling system not involving an acid/alum split. The acid/alum split procedure was formerly used at the AST in Building 3L to pretreat strong coolant solution prior to discharge to the treatment system [61]. Final settling takes place in two 100 ft by 150 ft unlined lagoons located east of the treatment plant. Currently, the wastewater treatment plant receives wastewater from Building No. 5-L (the American Optical Co. powerhouse). The plant operates 3 days per week for approximately 1.5 hours per day [10, p. 12, 14].

The lagoons are reportedly designed for the settling of solids from the process wastewater prior to discharge to the Quinebaug River through NPDES Permit Outfall No. 001 [13, p. 7]. American Optical Co. reported that sludge from the lagoons was pumped to an on-site fill area, the Old Landfill Area [12].

A second wastewater treatment facility operated on the property in Building No. 16 from an unspecified date until 1987. This system was designated the "plating waste treatment area" which also discharged wastewater to the Quinebaug River under discharge Permit No. MA0003361, Outfall No. 012. The system operated a neutralization process which precipitated heavy metals [12]. The sludge was then placed in drums, and the drums were placed in an enclosed diked storage area until the drums were transported off site by a licensed hauler [12]. American Optical Co. discontinued electroplating operations on 27 March 1987, and START assumes that the associated wastewater treatment plant also discontinued at or around this time [14].

In 1991, Rizzo collected three surface water samples (SL-1 through SL-3) from the Quinebaug River. See Figure 2 for the approximate locations of the surface water samples collected. The samples were analyzed for VOCs utilizing EPA Method 8260, and RCRA-13 metals via EPA Methods 6,000 to 7,000 series. Comparing the upstream reference sample SL-1, to the two downstream samples, no VOCs or metals were detected in the surface water [29, Table 3].

In November 1993, Rizzo collected six surface water samples (SW-1 through SW-6) along the Quinebaug River. Samples SW-1 and SW-2 were located upstream of the former TCA/DCM ASTs at Building No. 14, and downstream of the AO Ballfield Landfill. Sample SW-3 was collected in the Quinebaug River adjacent to the former TCA/DCM ASTs located at Building No. 14. Samples SW-4 and SW-5 were collected in the Quinebaug River north of Building 7-L and south (downgradient) of Tank Farm Nos. 1 and 2. Sample SW-6 was collected along the river south (downgradient) of the Old Landfill Area. The samples were analyzed for VOCs utilizing EPA Method 8260. Two VOCs, 1,1,1-TCA (8.6 ppb) and cis-1,2-DCE (1.5 ppb) were detected in a surface water sample at location SW-3 [2, Table 6-3].

In December 1993, Rizzo collected two surface water samples: a second surface water sample from the location of SW-6 (location previously collected during November 1993 sampling round) from the Quinebaug River, south of the Old Landfill Area, and a surface water sample from Rouge Brook, at the outfall of an abandoned drain line stretching underneath the landfill. The samples were analyzed for VOCs, metals, and cyanide [7, p. 15]. Rizzo sampled the outfall to Rouge

Brook again in May 1994; however, only laboratory data for the May 1994 analysis for metals from the outfall along Rouge Brook was available to START at the time of this report. A summary table provided by Rizzo for the May 1994 sampling round indicated that the outfall sample collected from Rouge Brook contained TCE, PCE, 1,1,1-TCA, cis-1,2-DCE, 1,1-DCA, zinc, lead, and arsenic at concentrations ranging from 2.2 ppb to 42 ppb for VOCs, and 50 ppb (lead) to 130 ppb (zinc) for total inorganic elements [22, Table 11].

START did not perform surface water pathway sampling as part of the American Optical Co. SIP. Based on analytical results from previous surface water sampling events, surface water on the American Optical Co. property has been impacted by a release of hazardous substances which appears to be at least partially attributable to on-site sources. Based on the above information, a fishery, a water body protected under the Clean Water Act, and a wetland environment are also likely to have been impacted by the release. Additionally, no known activities have been undertaken to remediate or reduce the effects of the release to surface water.

SOIL EXPOSURE PATHWAY

There are currently an estimated 1,060 employees working on the American Optical Co. property [10]. The nearest residence is located at 33 Crystal Street, approximately 300 ft west of the property [10]. The population residing within 1-radial mile of the property is estimated at 7,871 (not including on-site workers) [45].

Although there are portions of the American Optical Co. property that are surrounded by a fence and a security guard house at the main gate, there are some areas of the property that are accessible to the general public [10].

There are two on-site landfills associated with the American Optical Co. property (the Old Landfill Area and the AO Ballfield Landfill). START calculated the area of the Old Landfill Area to be approximately 268,201 ft² [23]. In 1988, American Optical Co. reported that part of the Old Landfill Area varied in depth from 10 ft to 40 ft. In 1996 and 1997, Rizzo completed closure measures at the Old Landfill Area consisting of temporary and permanent control measures including a gas venting system, a 12-inch clay layer, a 6-inch drainage layer, and a 6-inch vegetative support layer [25, p. 13].

The AO Ballfield Landfill consists of an approximately 40,200 yd³ (1,085,400 ft³) of dredged spoils from the Quinebaug River near Powerhouse Pond. Records do not indicate that any other material or waste were disposed of in the AO Ballfield Landfill. To date, no known previous sampling events have been conducted at the AO Ballfield Landfill.

Numerous soil samples have been collected during the installation of monitoring wells and advancement soil borings by Rizzo between 1989 to 1996 [2; 9; 7; 31]. The majority of these soil samples were collected from greater than 2 ft bgs. It should be noted that several of the sample intervals extend across the 2-foot shallow soil sample depth.

In June 1991, Rizzo submitted a second addendum to the Phase I report. As part of the Addendum 2 investigation, Rizzo excavated test pits and collected soil samples from the tank farm area, designated TF-1 through TF-24. The samples were collected at intervals from 0 to 1.5 ft and 1.5 ft to 3.0 ft. Samples from 20 of the test pits were analyzed for TPH, and two samples were analyzed for VOCs by a private laboratory utilizing EPA Methods. No VOCs were detected [27, p. 5]. TPH was detected in the majority of the soil samples and ranged in concentrations from 80 ppm to 31,200 ppm, with the highest concentrations located in the northern area of the tank farm [27, Table 2].

In June 1994, Rizzo advanced two soil borings (SB-01 and SB-02) in the area of the former TCA/DCM ASTs at Building No. 14, near monitoring well RIZ-6. Soil samples collected from SB-01 and SB-02 at depths ranging from 0 to 1 ft, 1 to 2 ft, and 2 to 3 ft were analyzed for VOCs via EPA Method 8260 and TPH via EPA Method 8100 [2, p. 29, Table 6-1]. Using SB-02 as a reference sample, TCE, PCE, 1,1,1-TCA, and 1,1,2-TCA were detected in SB-01 from 0 to 1 ft, and TCE, PCE, 1,1,1-TCA, and cis-1,2-DCE were detected from 2 to 3 ft in SB-01 at concentrations ranging from 8.3 to 150 ppb [2, Table 6-1].

START did not perform surface soil sampling as part of the American Optical Co. SIP. However, based on previous analytical data, a release of hazardous substances to surficial soils from on-site sources has been documented. Based on the site observations and conditions, property access restrictions, distance to nearest residence (300 ft), and lack of public use of the property, no impacts to nearby residential populations are known or suspected.

AIR PATHWAY

There are currently approximately 1,060 employees working on the American Optical Co. property [10]. The nearest residence is located at 33 Crystal Street, approximately 300 ft west of the property [10]. The population located within 4-radial miles of the property is estimated as 24,900 people (including on-site employees) [45]. Table 9 summarizes the estimated population within each target distance ring within 4-radial miles of the American Optical Co. property.

Table 9

Estimated Population Within 4-Radial Miles of American Optical Co.

| Radial Distance from American Optical Co. (miles) | Estimated Population* |
|---|-----------------------|
| On a source | 1,060 |
| > 0.00 to 0.25 | 304 |
| > 0.25 to 0.50 | 1,702 |
| > 0.50 to 1.00 | 5,865 |
| > 1.00 to 2.00 | 7,873 |
| > 2.00 to 3.00 | 4,313 |
| > 3.00 to 4.00 | 3,783 |
| TOTAL | 24,900 |

* The total population value includes the 1,060 on-site employees.

[10; 45]

Based on field observations, START estimates that there is approximately 1.0 acre of wetlands located on the American Optical Co. property [10]. An estimated 1,988 acres of wetlands are located within 4-radial miles of the American Optical Co. property. EPA reported that there are three State-threatened species located within 4-radial miles of the property [54]. CT DEP reported that there are no occurrences of State- or Federal-endangered/threatened species located within the Connecticut portion of the 4-radial mile distance ring from the American Optical Co. property [55]. The Quinebaug River and Rouge Brook are considered Clean Water Act-protected water bodies.

Table 10 summarizes the sensitive environments located within 4-radial miles of the American Optical Co. property.

Table 10

Sensitive Environments Located Within 4-Radial Miles of American Optical Co.

| Radial Distance from the American Optical Co. property (miles) | Sensitive Environment/Species Status |
|--|--|
| On a source | None |
| > 0.00 to 0.25 | Clean Water Act |
| | 6 Acres Wetlands (Includes area located on the property) |
| > 0.25 to 0.50 | 12 Acres Wetlands |
| > 0.50 to 1.00 | 65 Acres Wetlands |
| > 1.00 to 2.00 | 360 Acres Wetlands |
| | Two State-threatened species |
| > 2.00 to 3.00 | 515 Acres Wetlands |
| | One State-threatened species |
| > 3.00 to 4.00 | 1,030 Acres Wetlands |

[54; 55; 56]

In November 1995, Rizzo collected three grab air samples from interior parts of Building No. 14. The samples were analyzed for VOCs utilizing EPA Method TO-14 (modified) [7, p. 16]. Rizzo reported that some VOCs were present at "trace" levels; however, Rizzo did not define "trace" and did not provide analytical data for the sampling event in the Phase II report [7, p. 22].

During the 1997 on-site reconnaissance, START monitored on-site ambient air quality for START health and safety purposes utilizing a PID. A reading of approximately 60 units above background was recorded inside an unlocked monitoring well located approximately 50 ft southwest of the Old Landfill Area. No other reading above background was noted by START personnel during the two START on-site reconnaissances.

For the purposes of this SIP evaluation, it should be noted that the soil gas sample analyses conducted at the property by Rizzo in 1994 is not considered representative of ambient air conditions. Based on the available data, no release of hazardous substances to the ambient air from on-site sources is known or suspected to have occurred and no impacts to nearby or residential populations or sensitive environments are known or suspected.

SUMMARY

The American Optical Co. property is located at 14 Mechanic Street in the Town of Southbridge, Worcester County, Massachusetts, in an area zoned for heavy industrial use. The property consists of four parcels referenced as the Southbridge Tax Assessor's Map No. 29, Parcel No. 38; Map No. 37, Parcel Nos. 4 and 5; and Map No. 38, Parcel No. 1. There are approximately 37 buildings, along with numerous smaller storage buildings, located on the 140-acre American Optical Co. property. The property is bordered by Mechanic Street on the west, East Main Street on the south, woods on the east, and St. Mary's Cemetery on the north. Mr. David Butler of American Optical Co. indicated that the current American Optical Co. property is bordered to the north by the northern bank of the Quinebaug River and the southern boundary of the property owned by Schott Fiber Optics, Inc. (including the AO Ballfield Landfill) and not by Saint Mary's Cemetery. The Schott Fiber Optics, Inc. property was part of American Optical Co. until 29 May 1982. The Quinebaug River flows through the property from northwest to southeast. A small perennial stream (Rouge Brook) originates on the southeast portion of the property and discharges to the Quinebaug River.

American Optical Co. has manufactured eyeglass frames and lenses since 1833, and has been at the Southbridge location since 1865. Until the 1980s, American Optical Co. manufactured eyeglass products such as eyeglass lenses, eyeglass frames, and personal protective equipment including safety goggles, glasses, and respirators. The processes used in the manufacturing operations include injection molding, plating, solvent cleaning, baking, and freon drying. Waste from these processes include solvents, industrial oils, organic chemicals, plating wastes, various unspecified inorganic chemicals, acid and alkalies, oil sludges, plating sludges, and chemical compounds.

American Optical Co. currently utilizes some of the on-site buildings for wastewater treatment, power generation, and storage. American Optical Co. sold the property to Southbridge Association Limited Partnership (SALP) in 1987. SALP leases space in the on-site buildings to several companies unrelated to American Optical Co. Many of the companies utilize the same manufacturing processes that American Optical Co. has used at the same locations in previous years. Although current on-site companies (not related to American Optical Co.) conduct similar processes as American Optical Co., at the request of the Environmental Protection Agency (EPA), this Site Inspection Prioritization (SIP) has not included access to or evaluation of all on-site buildings. This SIP has focused on sources attributable to previous processes conducted on the American Optical Co. property without adding new potential sources attributed to companies leasing buildings from SALP.

There are currently approximately 1,060 employees working on the American Optical Co. property. The nearest residence is located at 33 Crystal Street, approximately 300 ft west of the property. The population located within 4-radial miles of the property is an estimated 24,900 (including on-site employees). START observed approximately 1 acre of wetlands on the property. There are an estimated 1,988 acres of wetlands located within 4-radial miles of the American Optical Co. property.

Roy F. Weston, Inc. (WESTON®) Superfund Technical Assessment and Response Team (START) evaluated 30 hazardous waste sources located on the American Optical Co. property. The majority of the sources were comprised of aboveground storage tanks (ASTs) and drums. Four sources of particular concern are described below.

American Optical Co. treats production process water through a process water treatment plant located on the southeast corner of the property. The water is treated via an acid/alum split which is used to separate soluble oils from the wastewater stream in the treatment plant prior to discharge to the sedimentation lagoons. The chemicals are stored in 55-gallon drums or smaller containers on concrete or bituminous concrete surfaces inside the building. Treated wastewater from the wastewater treatment plant is pumped to two approximate 100 foot (ft) by 150 ft lagoons. The lagoons are used for the settling of solids (including heavy metals) from the process wastewater prior to discharge to the Quinebaug River through a National Pollutant Discharge Elimination System (NPDES) (Permit No. MA0003361, Outfall No. 001).

Four 500-gallon ASTs were formerly located on the eastern side of Building No. 14. Two of the ASTs were used for the storage of trichloroethane (TCA), while the other two were used for the storage of dichloromethane (DCM). Rizzo Associates, Inc. (Rizzo) conducted numerous sampling events from 1989 to 1996 that indicated that groundwater, surface water, and soil in the vicinity of Building No. 14 is contaminated with volatile organic compounds (VOCs). During the START 1997 on-site reconnaissance, American Optical Co. representatives reported that the two DCM ASTs were removed and placed outside Building No. 2-L in 1988, and disposed of off-site in 1993. Additionally, American Optical Co. representatives stated to START that the two TCA ASTs were emptied in 1988, and removed from the property in approximately 1994. Although American Optical Co. has not provided documentation of the removal of the ASTs, for the purpose of this evaluation, START presumes that these ASTs have been removed but based on analytical evidence residual contamination exists in groundwater, surface water, and soil in the immediate area of the ASTs.

American Optical Co. maintains an on-site landfill (Old Landfill Area) on the southeastern border of the property. American Optical Co. reported that from 1979 to 1980, the following quantities of materials were estimated to have been disposed of in Cell Nos. 1 and 3 of the landfill: 4,308 cubic yards (yd³) of slurry; 1,941 yd³ of glass and plastic lenses; 1,625 yd³ of pitch and glass; 1,297 yd³ of tumbling pegs; 1,051 yd³ of yard brush; 544 yd³ of glass; and 182 yd³ of scrap cured resin. Cell No. 4 of the landfill has received brush, stumps, wood, and some concrete material. Additionally, American Optical Co. reportedly deposited dredged spoils from the Quinebaug River in the landfill.

A second landfill (AO Ballfield Landfill) is located on the northern border of the former property line. Currently, this property is owned by Schott Fiber Optics, Inc. During the 1978 dredging of the Quinebaug River, at Powerhouse Pond, approximately 40,200 yd³ [1,085,400 cubic feet (ft³)] of silt was transported by American Optical Co. to the AO Ballfield Landfill. No other records were available to START regarding additional disposal practices at the landfill. To date, no known samples have been collected from this landfill.

In excess of 70 monitoring wells have been installed on the American Optical Co. property. VOCs and metals have been detected in groundwater on the property, primarily from the area surrounding the former TCA/DCM ASTs and the Old Landfill Area.

American Optical Co. operates under an NPDES discharge (Permit No. MA0003361), issued in 1974, which allows discharge of non-contact cooling water, stormwater, and treated industrial wastewater in the Quinebaug River. Non-contact cooling waters are generated from on-site manufacturing processes and the powerhouse. American Optical Co. currently operates and discharges wastewater via 10 NPDES permitted outfalls to the Quinebaug River. American Optical Co. is required to sample each discharge for pH, flow volume, and temperature on a monthly basis. Three of the outfalls are additionally sampled for chlorine, due to the use of chlorine as a disinfectant for the cooling waters. American Optical Co. has not reported a release of chlorine above permit levels.

Surface water sampling events conducted by Rizzo in 1991 and 1993 indicate that VOCs and metals have been released to the surface water pathway from on-site sources associated with the American Optical Co. property. VOC concentrations range from 2.2 ppb to 42 ppb, while total metal concentrations range from 50 parts per billion (ppb) (lead) to 130 ppb (zinc).

In June 1994, Rizzo completed a *Phase II Comprehensive Site Assessment Report*. Rizzo conducted a Soil Gas Survey and reported that numerous VOCs including benzene, toluene, ethylbenzene, xylenes, and naphthalene were detected. Two soil borings (SB-1 and SB-2) were advanced in the area of the former TCA/DCM ASTs at Building No. 14. Trichloroethylene (TCE), tetrachloroethylene (PCE), 1,1,1-trichloroethane (1,1,1-TCA), and 1,1,2-trichloroethane (1,1,2-TCA) were detected in the sample collected from 0 to 1 ft in SB-01, and TCE, PCE, 1,1,1-TCA, and cis-1,2-dichloroethylene (cis-1,2-DCE) were detected from 2 to 3 ft in SB-01 at concentrations ranging from 8.3 to 150 ppb.

START has not conducted sampling as part of this SIP. However, based on previous sampling data collected between 1989 and 1994, a release of hazardous substances at least partially attributable to the American Optical Co. property, has been documented to impact on-site groundwater, surface water, and soils.

**AMERICAN OPTICAL CO.
REFERENCES**

- [1] USGS (U.S. Geological Survey). 1982. Southbridge, Massachusetts. (7.5-minute series topographic map).
- [2] Rizzo Associates, Inc. 1994. Phase II Comprehensive Site Assessment Report. 3 June.
- [3] NUS/FIT (NUS Corporation/Field Investigative Team). 1990. Final Screening Site Inspection. 25 September.
- [4] Kronopolus, J. 1982. Memorandum, RE: American Optical Corporation. 18 October.
- [5] Umstot, K. (START). 1997. Phone Conversation Record with Mr. David Butler (American Optical Co.), RE: Current Property Owner of the American Optical Co. Property. TDD No. 97-06-0016. 9 September.
- [6] Umstot, K. (START). 1997. Phone Conversation Record with Irene (Southbridge Assessor's Office), RE: Current Property Owner of the American Optical Co. Property. TDD No. 97-06-0016. 23 September.
- [7] Rizzo Associates, Inc. 1996. Phase II-Comprehensive Site Assessment and Human Health and Risk Characterization. 18 September.
- [8] Umstot, K. (START). 1997. Phone Conversation Record with Irene (Southbridge Assessor's Office), RE: Current Property Owner of Schott Fiber Optics on the American Optical Co. Property. TDD No. 97-06-0016. 20 October.
- [9] Rizzo Associates, Inc. 1990. Phase I-Limited Site Investigation Report. 8 March.
- [10] START. 1997. Field Logbook for On-Site Reconnaissance, American Optical Co. TDD No. 97-06-0016. 13 October.
- [11] American Optical Company. Solid Waste Management Unit. Undated.
- [12] Szczurko, S. (MA DEP) 1981. Memorandum, RE: Surface Impoundment Inspection. 19 January.
- [13] Rizzo Associates, Inc. 1988. Spill Prevention Control and Countermeasure Plan. 14 October (American Optical).
- [14] Butler, D. (American Optical Co.). 1987. Letter to Glen Gilmore, RE: State Permit No. 380, Federal Permit No. MA0003361. 5 February.

**AMERICAN OPTICAL CO.
REFERENCES (Continued)**

- [15] New England Industrial Waste, Inc. 1988. Report on the Follow-up Services Related to the Removal of Underground Storage Tanks at the American Optical Site. November.
- [16] EPA (U.S. Environmental Protection Agency). 1996. Comprehensive Environmental Recovery, Compensation, and Liability Information System (CERCLIS). Printout dated 12 September.
- [17] Unknown. Memorandum, RE: Powerhouse Pond-Dredge and Dispose of Fill Material-Summer 1978. Undated.
- [18] Gallerani, G. (MA DEP) 1981. Notification of Hazardous Waste Site. 22 May.
- [19] Gallerani, G. (MA DEP) 1981. Letter to Environmental Protection Agency, RE: EPA Notification of Hazardous Waste Site for Three On-site Landfills. 3 June.
- [20] American Optical Co. Site Map. Undated.
- [21] Rizzo Associates, Inc. 1991. Addendum to Phase I-Limited Site Investigation. 3 January.
- [22] Rizzo Associates, Inc. 1994. Comprehensive Solid Waste Site Assessment-Parcel 3 Landfill. 10 June.
- [23] Umstot, K. (START). 1997. Project Note, American Optical Co., RE: Area of Old Landfill Area. TDD No. 97-06-0016. 10 June.
- [24] Butler, D. (American Optical) 1994. Letter to Robert A. Bostwick (MA DEP), RE: Status Update. 7 March.
- [25] Rizzo Associates, Inc. 1996. Corrective Action Design-Alternative Landfill Final Cover System. 24 June.
- [26] American Optical Co. Southbridge Business Center Tenant List. Undated.
- [27] Rizzo Associates, Inc. 1991. Addendum II to Phase I-Limited Site Investigation. 5 June.
- [28] U.S. Department of Commerce. 1990. 1990 Census of Population and Housing, Summary Population and Housing Characteristics, Massachusetts. August.
- [29] Rizzo Associates, Inc. 1991. Notice of Deficiency Response. 8 August.

**AMERICAN OPTICAL CO.
REFERENCES (Continued)**

- [30] Rizzo Associates, Inc. 1992. Initial Site Assessment. 17 September.
- [31] Rizzo Associates, Inc. 1996. Human Health and Environmental Risk Characterization. 18 September.
- [32] EPA (U.S. Environmental Protection Agency). 1995. Resource Conservation and Recovery Information System (RCRIS) Superfund Program, Region I. Printout dated 7 July.
- [33] Rizzo Associates, Inc. 1994. Results of the Supplemental Investigation for Area 5. 6 September.
- [34] Umstot, K. (START). 1997. Phone Conversation Record with Ms. Nancy Smith (Environmental Protection Agency), RE: Method of Evaluation of the American Optical Co. Property. TDD No. 97-06-0016. 23 October.
- [35] Desmond, J. (MA DEP) 1986. Letter to Mr. David Butler (American Optical Co.), RE: Inspection of On-site Incinerator. 6 February.
- [36] Umstot, K. (START). 1997. Project Note, American Optical Co., RE: The Area of Contaminated Soil Surrounding the Former Solvent Tanks. TDD No. 97-06-0016. 31 October.
- [37] Umstot, K. (START). 1997. Project Note, American Optical Co., RE: The Area of Contaminated Soil Surrounding the Drum Storage Area. TDD No. 97-06-0016. 31 October.
- [38] USGS (U.S. Geological Survey). 1983. Bedrock Geologic Map of Massachusetts. Edited by E-an Zen.
- [39] National Oceanic and Atmospheric Administration. Monthly Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days, 1961-1990. Climatology of the United States, No. 81.
- [40] Umstot, K. (START). 1997. Phone Conversation Record with Mr. Steve Donovan (Southbridge Water Department), RE: Public Water in Southbridge. TDD No. 97-06-0016. 8 August.
- [41] Umstot, K. (START). 1997. Phone Conversation Record with Ms. Mary Stone (Town of Charlton), RE: Public Water in Charlton. TDD No. 97-06-0016. 8 August.
- [42] Umstot, K. (START). 1997. Phone Conversation Record with Ms. Mary Heckler (Town of Woodstock), RE: Public Water Supply in Woodstock. TDD No. 97-06-0016. 8 August.

**AMERICAN OPTICAL CO.
REFERENCES (Continued)**

- [43] Umstot, K. (START). 1997. Phone Conversation Record with Mr. John Meehan of the (Town of Dudley), RE: Public Water Supply in Dudley. TDD No. 97-06-0016. 8 August.
- [44] Umstot, K. (START). 1997. Phone Conversation Record with Mr. Greg Morse of the (Town of Sturbridge) , RE: Public Water Supply in Sturbridge. TDD No. 97-06-0016. 8 August.
- [45] Frost Associates. 1997. CENTRACTS Report for American Optical Co., Southbridge, Massachusetts, Reporting Population and Private Well Users within the Target Distance Limit. 22 August.
- [46] USGS (U.S. Geological Survey). 1969 (photorevised 1979). East Brookfield, Massachusetts, 1:25,000 scale topographic map. 7.5 Minute Quadrangle. TDD No. 97-01-0044.
- [47] USGS (U.S. Geological Survey). 1969 (photorevised 1975). Leicester, Massachusetts. (7.5-minute series topographic map).
- [48] USGS (U.S. Geological Survey). 1955 (photorevised 1970). Putnam, Connecticut. (7.5-minute series topographic map).
- [49] USGS (U.S. Geological Survey). 1982. Webster, Massachusetts. (7.5-minute series topographic map).
- [50] National Flood Insurance Program. 1982. Flood Insurance Rate Map, Town of Southbridge, Massachusetts. Panel 5 of 8. 15 March.
- [51] USGS (U.S. Geological Survey). 1987. Water Resource Data, Massachusetts and Rhode Island. Wateryear 1987.
- [52] USGS (U.S. Geological Survey). 1996. Water Resource Data, Massachusetts and Rhode Island. Wateryear 1996.
- [53] Massachusetts Department of Environmental Protection. 1990. Massachusetts Surface Water Quality Standards. Publication No. 16,484-114-100-10-CR.
- [54] Charest, G. (U.S. Environmental Protection Agency). 1998. Project Note, American Optical Co., RE: Rare and Endangered Species Report, American Optical Co., Southbridge, MA. TDD No. 97-06-0016. Undated.

**AMERICAN OPTICAL CO.
REFERENCES (Concluded)**

- [55] CT DEP (Connecticut Department of Environmental Protection). 1997. Sensitive Environment Report for the American Optical Co. Property, Southbridge, Massachusetts. 26 August.
- [56] Umstot, K. (START). 1997. Project Note, American Optical Co., RE: Wetlands Calculations. TDD No. 97-06-0016. 10 November.
- [57] EPA (United States Environmental Protection Agency). 1996. Superfund Chemical Data Matrix (SCDM). July.
- [58] U.S. Department of Commerce. 1990. 1990 Census of Population and Housing, Summary Population and Housing Characteristics, Connecticut. July.
- [59] Umstot, K. (START). 1998. Project Note, American Optical Co., RE: Flow Rate of Rouge Brook. TDD No. 98-05-0089. 29 July.
- [60] Umstot, K. (START). 1998. Phone Conversation Record with Mr. Dave Butler (American Optical Co.), RE: Trip Report Comments. 12 August.
- [61] Butler, D. (American Optical Co.). 1998. Comments to the Draft Site Inspection Prioritization Report. 27 August.